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THE PATHOGENESIS AND TREATMENT OF HYPERTENSION

ARTHUR GROLLMAN, M.D.

From the Department of Experimental Medicine, Southwestern Medical School of the University of Texas, Dallas, Texas

Recent experimental studies in the field of hypertension have contributed greatly to the elucidation of this common disorder and have reached the point where specific and potentially answerable questions can be formulated regarding its nature and pathogenesis. These findings have also paved the way for the hope that eventually methods may be found for the effective management of this disease.

An elevation in blood pressure is so commonly observed, particularly with increasing age, that it is not surprising that it was long considered as an inevitable consequence of the aging process. An observed deviation in blood pressure from the normal level may reflect either a loss in elasticity of the vascular system (arteriosclerosis), a disease entity designated as hypertensive cardiovascular disease (or simply hypertension), or a hemodynamic response to a great variety of stimuli. The last-named type is usually transient, whereas the first two reflect permanent systemic alterations in the organism. The fact that elevations in blood pressure may be caused by such diverse conditions has led to considerable confusion, as a result of the failure to differentiate the factors which may be responsible for an observed rise in blood pressure.

There has been an unfortunate tendency by both experimental workers and clinicians to designate all instances in which a rise in blood pressure is observed, as "hypertension." The term "hypertension" has thus been used synonymously with "an elevated blood pressure" (of either the systolic or the diastolic level), as well as for a specific disease process. Many workers, for example, have designated as hypertension the rise in blood pressure induced in animals by large doses of desoxycorticosterone and salt. This rise in pressure, first reported in the human and later in the rat, is transient and disappears on cessation of therapy. Only if the treatment is prolonged for many months, with damage to the kidney, does there ensue a permanent rise in blood pressure which may rightfully be called hypertension. The clinician, in turn, often applies the term "hypertension" to

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the arteriosclerotic individual with an elevated systolic (but relatively normal diastolic) blood pressure. This indiscriminate use of the term "hypertension" as synonymous with an elevation in blood pressure, is most undesirable. It has led to the view that "hypertension" is not a disease entity but merely a symptom, such as headache, resulting from a variety of causes. Such a conclusion, if accepted, would render any attempt at a consideration of the pathogenesis and treatment of hypertensive vascular disease entirely futile (1).

WHAT IS HYPERTENSION?

Much of the confusion which has just been described may be dispelled by confining the terms "hypertension" or "hypertensive cardiovascular disease" to a specific disease process characterized 1) hemodynamically, by a rise in blood pressure secondary to an increased peripheral resistance with a normal cardiac output, 2) clinically, by a varied rate of progression which may be so slow and accompanied by so few or no symptoms of complaints as to merit the term "benign," or which may be so rapidly progressive and reach such a state of serious disability with high mortality as to merit the term "malignant," and 3) pathologically, if the disease has been present for some time, by specific changes in the blood vessels (arteriolarsclerosis), heart (hypertrophy) and other tissues, which make possible the recognition of the disease at autopsy without knowledge of the level of the blood pressure during life.

The structural changes occurring in the arterioles and smaller arteries in patients with hypertension are characteristic of this disease and have been the subject of much comment. Some have felt that these changes are primary and that their occurrence in the vessels of the kidney result in an interference with the blood supply to this organ and consequently lead to the same effect as applying a clamp to the renal artery. However, practically all observers are now convinced that the structural changes in the blood vessels occurring in hypertensive cardiovascular disease are the result, rather than the cause, of the disease (2). These structural changes may be produced experimentally by bilateral nephrectomy, which results in hypertension (3). Not only are the characteristic lesions produced in this way but their evolution may be followed best in the nephrectomized animal as described in detail elsewhere and summarized in Figure 1. According to the view expressed in Figure 1, the acute necrotic lesions are characteristic of malignant hypertension. These acute lesions, as observed in the nephrectomized dog, undergo hyalinization with fibrous displacement of the vessel wall, hypertrophy of the media and conversion to the chronic arteriolar thickening characteristic of hypertension (Fig. 2).

As previously defined, hypertension may be looked upon as a specific disease entity, the pathogenesis of which may be considered as in the case of other disease processes. By excluding other conditions which have in common with hypertension only the hemodynamic characteristic of an elevated blood pressure, we avoid the inevitable confusion which dominates much of the medical literature dealing with this subject (1).

It is beyond the confines of the present paper to discuss in detail the clinical

features of hypertension, but a consideration of several fundamental aspects of the disorder are essential for a comprehension of what follows. As in the case of other chronic disorders, the severity of the disease may vary. It may be so mild as to be scarcely recognizable. This condition exists during the early stages of the disease, when the blood pressure is labile and becomes elevated only under stress. As the disease progresses, the hemodynamic disturbance which is reflected in the elevated systolic and diastolic blood pressure levels becomes more pronounced and permanent. At this stage, also, morphologic evidence of the changes in the vascular system may be evident during life by changes in the eye-

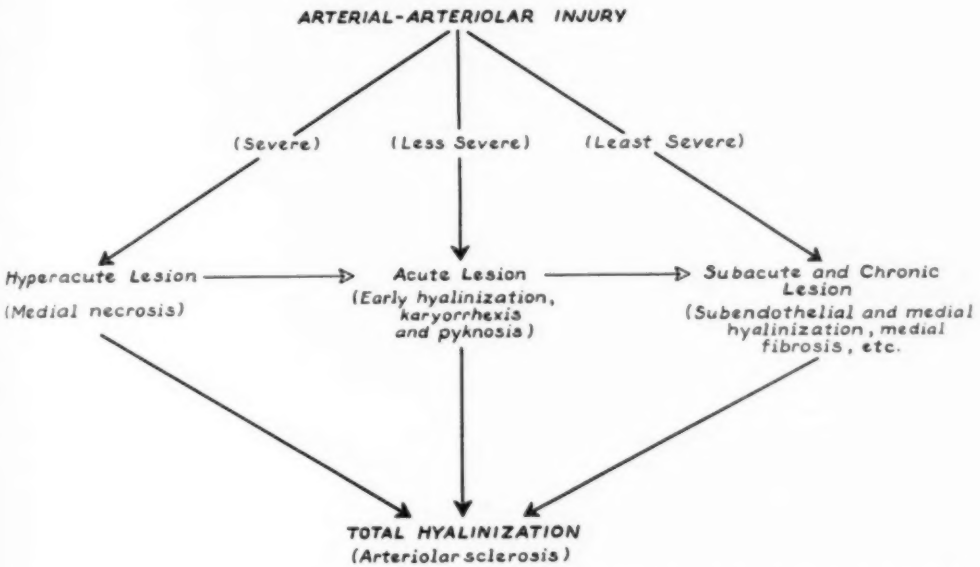


FIG. 1. A diagrammatic scheme depicting the pathogenesis of the lesions induced by nephrectomy. The injury to small arteries and arterioles varies in severity, thereby evoking different types of morphologic changes designated as the hyperacute, the acute, and the subacute and chronic. These lesions change in the directions represented by the arrows. The heavy arrows indicate the common pathways of change, mainly toward total hyalinization; the lighter arrows indicate alternate routes toward total hyalinization. Total hyalinization is considered as the fully developed stage of arteriolarsclerosis.

grounds and heart. The severity of the process and the resistance of the end-organs (such as the heart, brain, kidney and blood vessels) will determine the clinical course of the disease, the fate of the individual, and the ultimate appearance of the tissues at autopsy.

The ease with which blood pressure readings may be made has naturally led to overemphasis on this single and notoriously variable hemodynamic factor in the evaluation of the severity of the hypertensive process. This has unfortunately led to erroneous concepts regarding the incidence, course and nature of the disease. It is difficult, for example, to define the limits of normal blood pressure, because of the many variables modifying a given reading. That there is an elevation in blood pressure with increasing age, is well established; this rise is

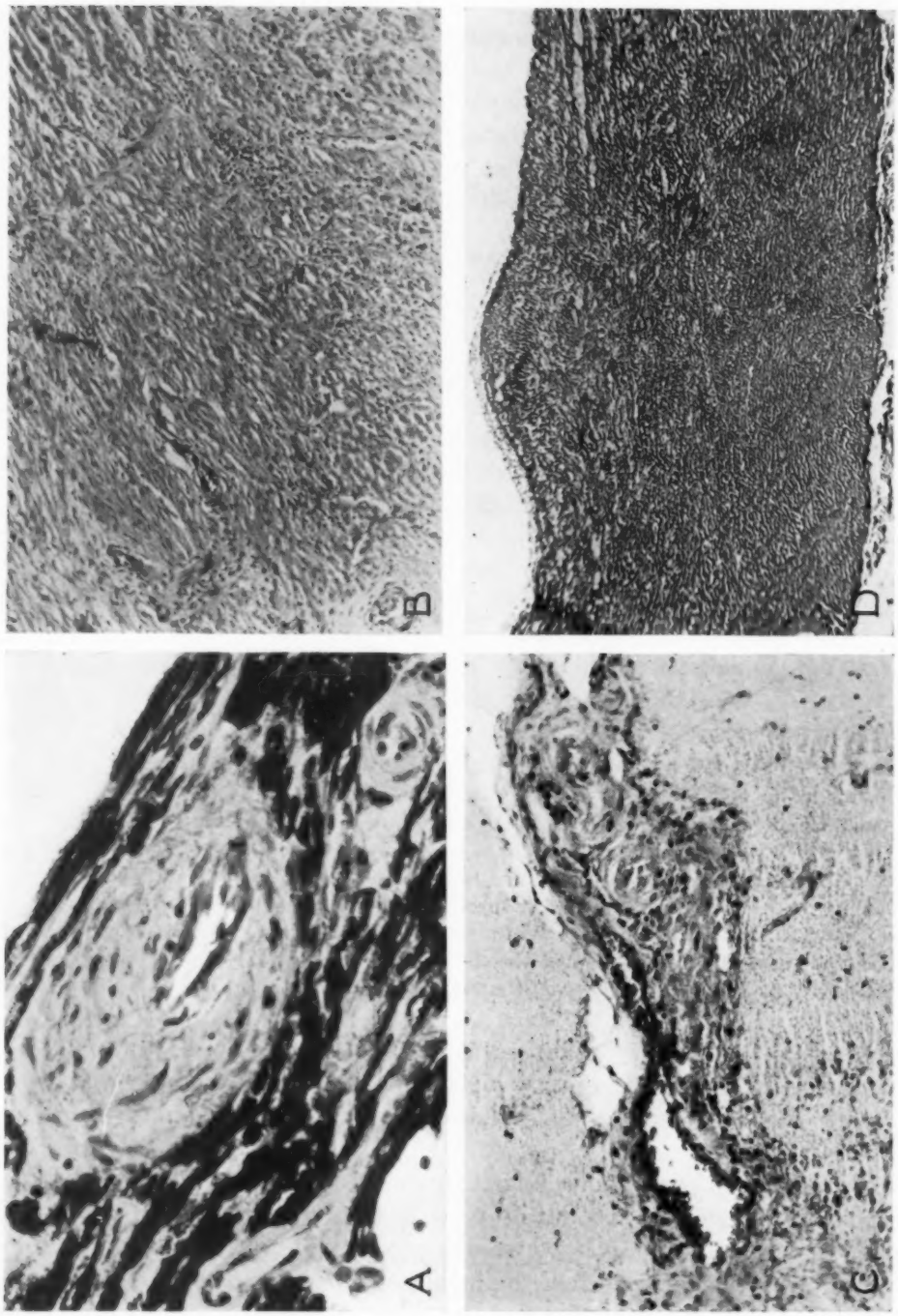


FIG. 2. Characteristic lesions of hypertensive cardiovascular disease, as induced in the bilaterally nephrectomized and adrenalectomized dog. Note the similarity of these experimental lesions to those observed in the human.

A. A section of the choroid of the eye showing the thickening of the wall and the replacement of muscular elements by connective tissue, with narrowing and displacement of the lumen of an arteriole. × 670.

B. A section through the myocardium showing an area of fibrosis in the left ventricle. × 140.

C. A section of the brain, showing the thickening and hyalinization of the arteriolar walls, with narrowing of the lumen and hemorrhage into the parenchyma. × 260.

particularly rapid and greater in females than in males after the age of 40. The high incidence of hypertension in the normal population, particularly in the older-aged group, is also well established. However, in view of the relatively benign nature of the disorder in many of these people, they may live their normal life span without complications related to the blood pressure. This has led to the view that perhaps the term hypertension should not be properly applied in these instances (4). This is merely begging the question, for the evidence of increased mortality in these subjects manifesting an elevated blood pressure indicates that this condition is definitely pathologic. Most authorities accept a casual systolic pressure of 180 and diastolic of 110 as representing a limit for defining a truly normal level in the aged. Only those persons manifesting an elevation in the diastolic level should be considered as suffering from "hypertension" in the sense in which this term is being used here.

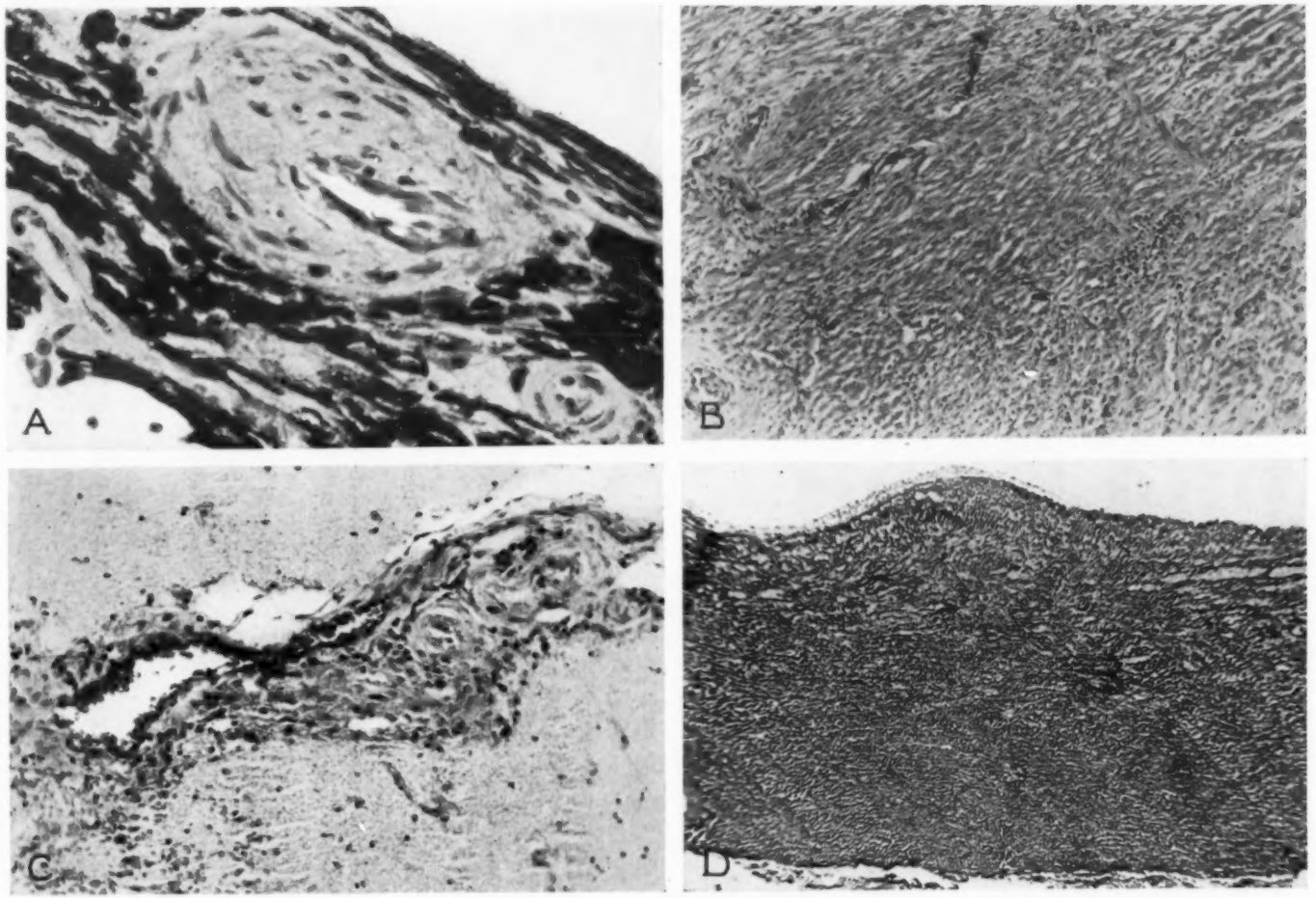
THE RENAL ORIGIN OF HYPERTENSION

The renal origin of hypertension is well established experimentally (1), although the mechanism whereby the kidney brings about this disordered function is still a matter of conjecture. Hypertension can be induced in the experimental animal by a great variety of methods, all of which have in common the fact that they involve some alteration in the function or structure of the kidney. Hypertension can be induced, for example, by limiting the blood supply to one kidney and removing the contralateral organ; by removing both organs; by dietary restrictions which damage the kidney; or by nephrotoxic agents. All of these procedures result not only in an elevation in the systolic and diastolic blood pressures but also in increased peripheral resistance, cardiac hypertrophy and changes in the smaller arteries and arterioles which characterize the disease in the human, as defined in a preceding section. Other procedures, such as denervation of the regulatory nerves in the aorto-carotid system, injury to the brain, or the injection of desoxycorticosterone or other steroids with salt feeding, may elevate the blood pressure but fail to produce the sustained rise and hemodynamic and pathologic changes characteristic of experimental renal hypertension (1).

In the human also, it is possible to ascribe the observed incidence of hypertension as etiologically related to some renal deficiency. This may be due to some congenital defect in the function of this organ as in so-called "essential" hypertension, to structural lesions acquired through infections as in the nephritides, or to vascular disturbances as in periarteritis and in Cushing's disease—all of which interfere with renal function. Although one cannot detect by the usual methods of examination any structural defect in the kidney in the early stages of essential hypertension, more exact cytologic studies reveal an enzymatic distortion in the pattern of kidney function (5).

The primary role of the kidney in the etiology of experimental hypertension is generally accepted (2). However, many investigators are averse to considering the disease in the human as a counterpart of that induced in the experimental animal. This aversion is unjustified, for the disease as it occurs spontaneously

B. A section through the myocardium showing an area of fibrosis in the left ventricle. × 140.
C. A section of the brain, showing the thickening and hyalinization of the arteriolar walls, with narrowing of the lumen and hemorrhage into the parenchyma. × 260.



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D. Section through the aorta showing an area of medial degeneration. × 50

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in the human and as produced in the experimental animal are identical as regards their clinical course, hemodynamic features and pathologic characteristics. Indeed, the resemblances of the condition between the different animal species (including the human) are much closer than is the case with other diseases, the identity of which in the human and experimental animal is taken for granted. Such basic characteristics of the hypertensive state as the reaction to sodium depletion, the excretion of antidiuretic hormone, the increased extracellular fluid volume and, above all, the reaction to various therapeutic agents, are identical in the human and experimental animal suffering from hypertension. It is, accordingly, justifiable to accept the condition as it occurs in the human as identical with that in the experimental animal and to examine critically the assumptions made regarding the pathogenesis and treatment of the disease in the human, in the light of the results observed in the experimental animal.

THE PATHOGENESIS OF RENAL HYPERTENSION

The renal origin of hypertension is so well established experimentally and so plausible, that it has been widely accepted (2). The mechanism whereby the renal defect brings about the disease, on the other hand, has been explained on the basis of a number of divergent hypotheses. It was first believed that hypertension results from the liberation by the kidney of a pressor agent—angiotonin or hypertensin—elaborated from renin. This simple theory, however, is in conflict with so many observed facts as to be untenable. Evidence against the renin hypothesis has been summarized elsewhere (6). Suffice it to refer here only to the fact that hypertension can be induced by nephrectomy, and that renin is not demonstrable in the blood of the chronic hypertensive animal or human being; these observations cannot be harmonized with the renin hypothesis.

It is possible that a pressor agent elaborated by the kidney may be concerned in certain acute rises in blood pressure such as are observed after hemorrhage, in acute glomerular nephritis, in eclampsia and possibly in certain rare instances of a unilateral renal lesion.

The observations that sodium restriction results in a reduction of blood pressure in some hypertensive patients, that the sodium content of the tissues in the hypertensive patient is increased in association with a decrease in potassium content, that the rate of excretion of the antidiuretic principle is increased in experimental and human hypertension, that desoxycorticosterone increases the blood pressure, and that the extracellular volume is increased in hypertension, all point to a disorder in electrolyte-water balance. Since the adrenal cortex is so intimately associated with salt and water metabolism, it was logical to conclude that this endocrine organ might in some way be concerned in the pathogenesis of hypertension. However, the demonstration that adrenalectomized dogs, maintained without recourse to hormonal therapy, may be made hypertensive and show the lesions characteristic of hypertension (as shown in Fig. 2) would contradict this simple assumption as to the mechanism of the disease (8). The older views attributing hypertension to overactive adrenal medullary tissue or to the pituitary have been shown to be erroneous (9, 10).

The nervous system has long held a dominant role in theories concerning the pathogenesis of hypertension. In view of the role of the sympathetic nervous system in the regulation of vascular tone, it has been assumed that psychogenic stimuli, either by general vasoconstrictor effects or by localized vasoconstriction of the renal vessels, result ultimately in a permanent state of hypertension. Critical examination of the evidence offered in support of this theory yields no convincing support for it; such objective evidence as is available fails to substantiate it (1, 2). Nervous and psychogenic influences may, to be sure, influence the level of the blood pressure, and their removal in the hypertensive subject may result in a decline in blood pressure, but this in no way implies that such stimuli alone suffice to induce the disease.

The clinical observations which have been presented in support of the neurogenic origin of hypertension are equivocal or amenable to other explanations. The claim, for example, that hypertension is a consequence of the tensions, conflicts and stresses of modern civilization are contradicted by the observation that the disease is equally prevalent among primitive peoples (1, 2). Attempts to induce hypertension in animals by psychogenic and nervous stimulation have failed. The claim that the condition can be induced in the rat by audiogenic stimulation has not been confirmed in the author's laboratory and in any case such stimuli cannot be considered as analogous to the psychogenic stresses assumed to be the etiologic factors in the human. The elaborate schemata purporting to show the role of the central nervous system acting through the hypothalamus on the pituitary, adrenal and vasomotor centers to elevate the blood pressure either directly or through the mediation of the kidney, must be considered as purely speculative without supporting experimental evidence.

Accepting the view that a defect in renal function is responsible for hypertension, there is ample evidence to show that this defect is neither nervous in origin nor associated with an excretory defect in kidney function (9). There remains the possibility that the kidney, in addition to its excretory function, maintains some metabolic activity or produces some incretory product, the absence of which from the organism results in the manifestation of hypertensive disease. The last-named possibility is supported by experiments in which the ingestion of certain renal extracts resulted in a fall in blood pressure in the hypertensive animal. Unfortunately, the small amount of this principle obtainable from renal tissue has deterred its clinical application and its further study. A material obtainable from partially oxidized and hydrolyzed marine oils exerts a similar hypotensive effect (10). The active principles derived from these two sources appear to be identical, judging from the similar absorption curves manifested by purified concentrates derived from renal tissue and from oil extracts, respectively.

THE RELATION OF ARTERIOLARSCLEROSIS TO HYPERTENSION

An understanding of the relation of arteriosclerosis to hypertension is important, for the two conditions are often confused by clinicians because of the fact that in both there is an elevation in systolic blood pressure. The two con-

ditions must be considered as fundamentally distinct disorders; but they are related in the sense that long-sustained hypertension results in morphologic changes in the large as well as in the smaller branches of the arterial tree, and arteriosclerotic and atherosclerotic alterations of the vessels to the kidney will result in renal hypertension in the manner envisaged by Goldblatt in his classic experiment.

We may, according to this view, consider generalized arteriolarsclerosis to be a consequence of hypertensive cardiovascular disease which, by its effects on the smooth muscle of the blood vessels, results secondarily in the morphologic changes seen at autopsy. On the other hand, vascular changes such as those observed in nephrosclerosis (if primary) may, by affecting renal function, result in hypertension. Arteriosclerosis involving tissues other than the kidney merely causes an elevation in the systolic blood pressure and does not give rise to hypertensive cardiovascular disease. This concept is in accord not only with the available data but also accounts adequately for the facts as observed clinically. The increased prevalence of arteriosclerosis with age, according to this view, accounts for the increasing incidence of systolic hypertension with age as well as for hypertensive cardiovascular disease, since the renal vessels are so commonly involved in the arteriosclerotic process. It is more logical, therefore, to attribute the observed increased frequency of an elevation in diastolic and systolic blood pressure to hypertensive vascular disease, than to assume with some observers that this rise is a normal concomitant of the aging process. Fortunately, the process in most cases is benign clinically, and in the present state of our therapeutic impotence may well be ignored insofar as the patient is concerned. It is the level of the diastolic pressure which serves as a measure of the degree to which hypertensive disease complicates the arteriosclerotic involvement and it is this level which is more important from a prognostic point of view.

THE TREATMENT OF HYPERTENSION

In sharp contrast to our increasing knowledge of the nature and pathogenesis of hypertensive cardiovascular disease are the relatively impotent measures available for its therapeutic management. In fact, with the better understanding of the disorder, the irrationality and uselessness as well as the potential harmfulness of many of the measures previously advocated have become obvious. The effects of reassurance and other psychotherapeutic procedures, the use of sedatives, rest, reduction in weight, and the development of a congenial "doctor-patient" relationship are well established measures in reducing the blood pressure, but they lack the fundamental significance which some have attributed to these procedures.

Drug therapy has depended on the use of agents causing vasodilatation, either by direct action on the blood vessels (nitrites), by their effects on the central nervous regulatory mechanisms (barbiturates, thiocyanate, veratrum) or by their adrenolytic and sympatholytic actions (hexamethonium, hydrallazine). This constitutes an irrational therapeutic approach, except perhaps in the case of hypertensive crises in which the acute rise in blood pressure per se may be

detrimental to the organism. It has been the general experience that, despite the optimism heralding their introduction, the aforementioned depressor drugs have to be ultimately discarded, since they prove ineffective in moderate dosage and are accompanied by violent side effects when the blood pressure is actually lowered (12).

Sympathectomy was introduced originally as a treatment for hypertension, on the assumption that interruption of the vasoconstrictor innervation of a large area of the vascular bed would lower the blood pressure. The extent of the denervation, its indications and its effectiveness have been the subject of disagreement and the procedure, which at best could only be considered as a stop-gap used for the lack of a rational therapeusis, appears to have lost its former popularity (13).

Recently, adrenalectomy, complete or partial, has been used experimentally in the treatment of hypertension. Despite the sanguine claims for its value, the fact that malignant hypertension may be induced in the absence of the adrenals (*cf.* Fig. 2) would make one hesitate to accept so drastic a procedure for a disease amenable to at least some measure of control by less rigorous methods.

Dietary restrictions in the control of hypertension have long been used. The only such procedure of any demonstrated value is the restriction of sodium, which in certain individuals has been shown to result in a reduction in blood pressure and in the amelioration of the condition (14). The effects of such drastic regimens as the rice or fruit diets have been shown to depend entirely on their low sodium content; hence they are of no virtue, except for temporary use in severely ill patients (15). The rationale for the use of sodium restriction is apparently based on the demonstrated deviations of the sodium-water metabolism in hypertension. Sodium restriction must be considered at best as only a procedure used because of the lack of a more effective and more fundamental approach to the problem. When properly applied, it is at least less hazardous, less expensive, and more effective than the alternative medicinal and surgical approaches to the problem.

None of the procedures outlined above affects the fundamental renal defect in hypertension, and at best can be considered only as a means of altering the manifestations of the disease. The assumption that renin plays a fundamental role in the pathogenesis of hypertension has led to futile attempts at immunization against the pressor effects of this substance (6). Crude extracts claimed to have an anti-renin action have been shown to exert such hypotensive effects as they may possess because of their pyrogen content. Pyrogens, in turn, have proven too noxious and violent to be considered of even palliative value.

From a theoretical viewpoint, the use of renal extracts as a form of substitution therapy would appear to be the logical approach to rational therapeutics, if one accepts the renal origin of hypertension, as described previously. Future studies must elucidate the possibilities of this approach to the problem.

SUMMARY

Recent studies on the pathogenesis and treatment of hypertensive cardiovascular disease have been reviewed. This disorder has been considered as a

specific disease process rather than as a symptomatic manifestation characterized by a rise in blood pressure. Hypertensive cardiovascular disease is believed to be a result of a renal defect originating from a variety of causes (congenital and acquired) which have a common factor, in that they induce a renal disturbance resulting in the hemodynamic, clinical and pathologic pattern characteristic of hypertensive disease. The interrelation of arteriosclerosis and hypertension and the significance of this relationship have been discussed. The inadequacy of the various therapeutic approaches to hypertension has been emphasized.

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REGULATION OF FLUID AND ELECTROLYTE BALANCE IN AGED PERSONS

JOHN H. BLAND, M.D.

University of Vermont College of Medicine, Burlington, Vermont

Dr. Homer Smith (1) has deftly summarized the role of the kidney in regulating fluid and electrolyte balance, by saying that the composition and volume of the blood and the internal environment are determined not by what the mouth ingests but by what the kidneys keep. In contradistinction to the lungs, skin and gastro-intestinal tract, the normal kidneys serve their owner by conserving or excreting fluid and electrolytes according to the needs of the organism in regard to volume, composition, concentration and pH.

I should like to discuss the principle physiologic mechanisms by which the normal kidney maintains homeostasis and then briefly review the alterations in body fluid and electrolytes in abnormal states.

The role of the kidney has been aptly represented by the observation that the heart at one end is working as hard as it can to pump a large quantity of water out of the body, and at the other end the kidneys are working equally hard to defeat the heart by retaining 99 per cent of this water in the body (1). Our lives depend on neither of them winning out. Figure 1 illustrates relative rates of flow in the nephron. The maintenance of normal volume and tonicity of body fluids is mainly a kidney responsibility. The renal handling of fluid and solutes envisages a very large volume of glomerular filtrate (180–200 liters per twenty-four hours) being transformed into a much smaller volume of bladder urine. The bladder urine or end-result of tubular treatment of the filtrate is altered a great deal in volume, composition, tonicity and pH. The proximal portion of the kidney tubule is in greatest part responsible for the decrease in filtrate volume and to a much less degree for change in its composition. It is the consensus that about 80 per cent or approximately 150 liters per twenty-four hours is reabsorbed before reaching the distal segment (2, 3). It is probable that the proportions of reabsorption of water and osmotically active particles in the proximal tubule are in such ratio that no change in osmotic pressure of the tubular urine occurs. It remains in isotonicity with extracellular water. The tubular epithelium is responsible for these alterations. In the distal tubule the filtrate is made more or less concentrated; water and salt are reabsorbed or excreted, depending on homeostatic dictates; and ammonia, hydrogen and potassium may be added.

There are mechanisms present in the distal convoluted tubule for the relatively separate control of water and salt reabsorption. The rate of tubular reabsorption of water in the distal tubule is normally maintained by the water-retaining hormone of the posterior pituitary. The primary action of the water-retaining hormone is stimulation of the distal tubular segment to reabsorb water and probably simultaneously to reject salt. In the absence of the water-retaining hormone

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(diabetes insipidus) the maximal urine flow would approximate about 15–20 per cent of the glomerular filtrate or ±30 liters (4). Smith, Wesson and Anslow (5, 6) are of the opinion that a fixed fraction of the glomerular filtrate and its contained electrolyte escapes the proximal tubule. If there is no water-retaining hormone activity, all or most of the water arriving in the distal tubule is excreted. Ranson (7) has shown that the posterior pituitary is controlled by centers

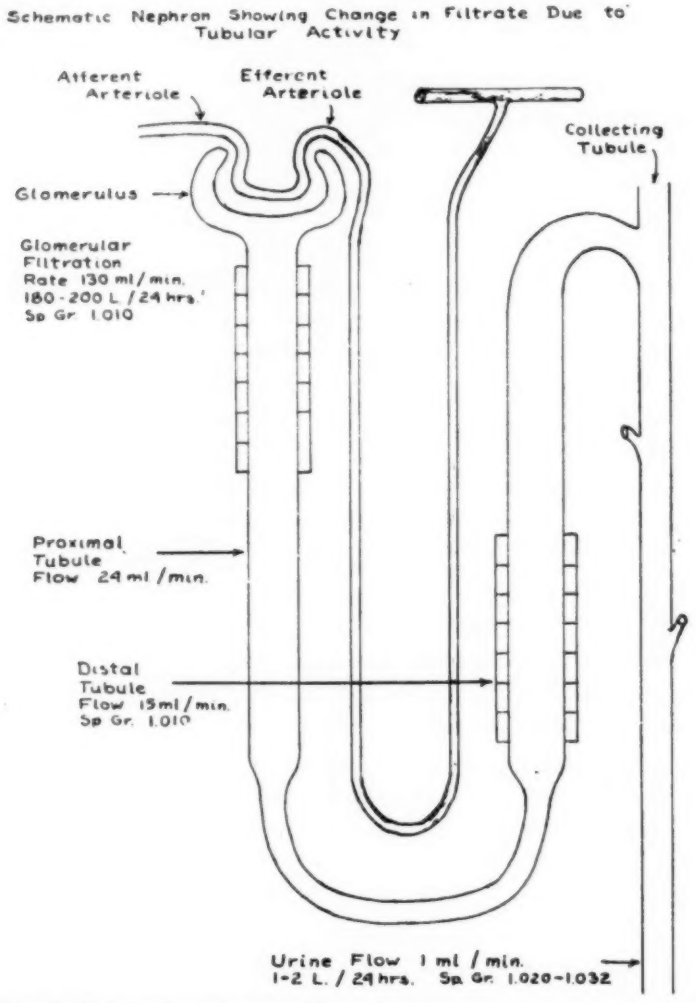

Schematic Nephron Showing Change in Filtrate Due to Tubular Activity
Afferent Arteriole
Efferent Arteriole
Collecting Tubule
Glomerulus
Glomerular Filtration Rate 130 ml/min. 180-200 L/24 hrs. Sp Gr 1.010
Proximal Tubule Flow 24 ml/min.
Distal Tubule Flow 15 ml/min. Sp Gr 1.010
Urine Flow 1 ml/min. 1-2 L/24 hrs. Sp Gr 1.020-1.032

FIG. 1. For explanation of this and subsequent figures, *see* text

in the hypothalamus. Hypothalamic injury, hypothalamic-pituitary fiber tract injury, or injury to the gland itself, effectively suppresses the supply of water-retaining hormone and diabetes insipidus results.

Verney (8) postulates the presence of osmoreceptors in the hypothalamus, which respond to an increase in tonicity of fluid bathing them by stimulating the posterior pituitary to secrete water-retaining hormone. A decrease in the tonicity of fluid bathing the receptor produces a reduced stimulus to the posterior

pituitary and a graded suppression of secretion of water-retaining hormone. The physiologic chain of events is as follows: in states of either actual or relative available excess water, the hypothalamus, presumably by osmoreceptors in this area, stimulates the posterior pituitary, which shuts off the supply of water-retaining hormone; the distal tubular cells reject water (and probably reabsorb salt), giving rise to a water diuresis—or, as Verney has called it, a physiologic diabetes insipidus. On the contrary, in states of water deprivation, the hypothalamus is stimulated, water-retaining is hormone secreted, the distal tubular cells reabsorb water (and probably reject salt), and the kidney excretes a more concentrated urine; thus water conservation is effected. Hence, by virtue of these hypothalamic "osmostats", the kidney excretes or retains water according to the needs of the organism.

There exists considerable evidence that the posterior pituitary may also respond to the stimulus of a diminution in plasma volume or some function of such a diminution (9, 10). In the presence of a decrease in plasma volume, there occurs an increased secretion of water-retaining hormone and a retention of water in

Comparison of Concentration of Various Substances in Glomerular Filtrate and Urine

	Glomerular Filtrate	Urine
Urea	0.150 Gm./L.	15 Gm./L.
Sodium	142 mEq./L.	120 mEq./L.
Chloride	103 mEq./L.	110 mEq./L.
Potassium	5 mEq./L.	50 mEq./L.
Phosphate	1 mM./L.	25 mM./L.
Sulfate	1 mEq./L.	20 mEq./L.
Glucose	80–120 mg.%	0
Ammonia	0	30 mEq./L.

FIG. 2

excess of salt, by the distal tubules. Welt and Orloff (11) have reported a corresponding marked increase in the excretion of water produced by expansion of plasma volume following infusion of iso-oncotic albumin. This increase in water excretion is presumably produced by suppression of the water-retaining hormone in response to an expanded plasma volume. The extent to which water is reabsorbed in the distal tubule constitutes the most important consideration in the rate of water excretion. The reabsorption of water in the distal tubule is under the influence of the posterior pituitary, and the stimulus this gland receives may be modified by changes in tonicity and to some degree by plasma volume.

The processes of the distal tubular cell for secretion of certain substances into the tubular filtrate and reabsorption of others back into the plasma water are accomplished by osmosis. An idea of the magnitude of such work in the case of any urinary constituent can be obtained by a comparison of the concentration of that substance in the glomerular filtrate with its concentration in the bladder urine. Figure 2 shows varying concentrations of urinary constituents in the

glomerular filtrate compared to their concentrations in the bladder urine, in the normal state. The capacity of the transport system in the tubular cells for any filtrate component, whether it be a shared or a private transport mechanism, is a fundamental limitation of tubular function. Transport systems are not well understood but a considerable body of evidence indicates that they are specific enzyme functions. Perhaps the best known transport mechanism is that for glucose. When the activity of the enzyme phosphorylase is inhibited by phlorhizin, glucose is not reabsorbed and glycosuria results. More recently the enzyme, carbonic anhydrase, has been inhibited in the distal tubule experimentally by the drug 6063, a sulfonamide relative; the result has been a suppression of hydrogen ion formation, depressing the function of acidification of the urine and presumably increasing the secretion of potassium ions by distal tubular cells (12).

It has long been known that the reabsorption of sodium and potassium in the tubules is in part under the control of the adrenal cortex (13). The desoxycorticosterone (DCA)-like hormones are most potent in causing sodium retention and potassium excretion. Hormones with oxygen atoms at the 11 and 17 positions are less active in water and electrolyte influences. Thus in adrenocortical insufficiency there occurs the familiar sodium excretion and potassium retention. Adrenocortical hyperactivity initiated by various stress phenomena results in sodium and chloride retention and potassium excretion.

In normal circumstances sodium levels in extracellular water are maintained in the range of 134 to 142 mEq./liter by virtue of appropriate renal excretion. If sodium intake is stopped altogether the urinary sodium level declines in a few days to 1 or 2 mEq./liter. It has been shown that during salt restriction the zona glomerulosa of the adrenal cortex hypertrophies, presumably due to an increase in output of DCA-like steroids; during sodium excess the zona glomerulosa decreases in size as the output of DCA-like steroids declines. Also, during potassium depletion the zone decreases in size but during potassium excess, hypertrophy occurs. This is in accord with the influence of DCA on the renal excretion of these electrolytes (14).

Berliner and associates have shown that suppression of hydrogen ion formation by inhibition of carbonic anhydrase in the distal tubule leads to an increased secretion of potassium ions into the tubular urine. They had previously shown that secretion of potassium ions by the distal renal tubules is necessary to account quantitatively for potassium excretion during rapid rates of administration (15), and that this secretory process of potassium loss is one of ion exchange—sodium ions from the tubular lumen being exchanged for potassium ions within the cells of the distal tubule. The now familiar secretion of hydrogen ions during the acidification of the urine and the exchange for sodium ions was known to them. It was also known that carbonic anhydrase was a component of the system by which hydrogen ions were made available for this ion exchange process, thus making the normal process by which urine is acidified also one by which sodium is reabsorbed. Berliner *et al.* (15) showed that inhibition of carbonic anhydrase produces a loss of capacity to acidify the urine and also produces a marked rise in potassium excretion. Figure 3, modified slightly from Pitts' lucid diagram,

depicts this relationship. If the reader will ignore the part of the illustration in parentheses, the normal mechanism is shown with hydrogen ion being exchanged across the luminal margin for a sodium ion, thus effecting base conservation and converting disodium phosphate to sodium acid phosphate. In experimental suppression of hydrogen ion formation by carbonic anhydrase inhibition, the normal balance between potassium and hydrogen ion concentrations in the distal tubule is tipped in favor of potassium and this ion is exchanged for sodium. The word "suppression" with its arrow is meant to indicate inhibition of carbonic anhydrase and consequent decrease in hydrogen ion formation. The "K^+" with its arrow

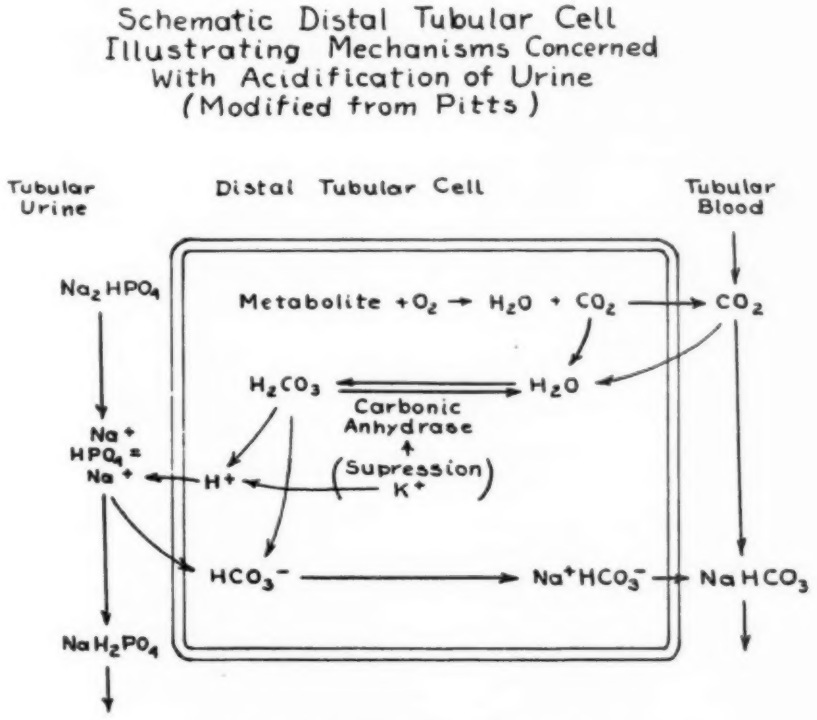


FIG. 3. (Modified from Pitts (18))

indicates movement of potassium ion into the tubular urine in exchange for sodium ion, as hydrogen ion becomes unavailable.

The concept that there is competition between hydrogen and potassium ions for some component of the ion exchange mechanism by which sodium is reabsorbed in the distal tubules is supported by the fact that elimination of hydrogen ion secretion into the urine leads to augmented secretion of potassium by the distal tubules (15). Alkalosis of body fluids is associated with potassium loss. Acidosis of body fluids is associated with potassium retention. Normal potassium excretion is, at least in part, carried out by a mechanism in which the hydrogen ion plays a competitive role. Potassium secretion by ion exchange is, then, probably a more or less continuous process and may well account for a considerable part of the normal excretion of potassium (12, 15). This may represent an un-

usual instance in which the normal kidney turns on its owner and loses potassium at a time, during alkalosis, when it may be sorely needed.

Two mechanisms are responsible for maintaining the mildly alkaline nature of the body fluids. The lungs maintain constancy of concentration of carbonic acid within the narrow limits of 1.2 to 1.4 mm./liter. The kidneys have the responsibility for the preservation of the constancy of bicarbonate concentration within limits of 25 to 27 mEq./liter. The kidneys accomplish their task by virtue of two mechanisms. The first of these is the recovery of the large amounts of bicarbonate which enter the renal tubules each day. The magnitude of tubular cell work can be appreciated if one notes that about 200 liters of plasma is filtered each day and each liter contains 25 mEq. of bicarbonate. A total of 5,000 mEq. of bicarbonate, or 454 Gm. expressed as sodium bicarbonate, enters the tubules in twenty-four hours. This salt must be filtered over and over again, as it represents five times the bicarbonate concentration of the body as a whole. The efficiency of the reabsorptive process is apparent when it is noted that the amount of bicarbonate which appears in the urine each day is only 1 or 2 mEq. However, if the diet has an alkaline-ash residue or sodium bicarbonate has been ingested, the excess appears in the urine for excretion.

Methods of Conservation of Base

$$Na_2HPO_4 + H_2CO_3 \rightarrow \underset{\text{(excreted)}}{NaH_2PO_4} + \underset{\text{(absorbed)}}{NaHCO_3}$$

$$Na_2SO_4 + 2NH_4HCO_3 \rightarrow \underset{\text{(excreted)}}{(NH_4)_2SO_4} + \underset{\text{(absorbed)}}{2NaHCO_3}$$

FIG. 4

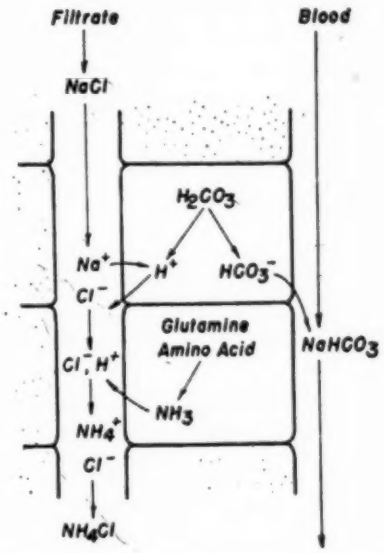
The second mechanism for maintaining bicarbonate concentration is concerned with the nonvolatile acids, such as phosphoric and sulfuric acids, formed daily in considerable amounts from the metabolism of phospholipids and proteins. Body base contributed by bicarbonate neutralizes these acids for transport. This process tends to deplete body stores of bicarbonate and this depletion is prevented by two tubular compensatory mechanisms, namely the secretion of titratable acid and the secretion of ammonia (16, 17).

These two mechanisms reverse the process of neutralization, allow of the excretion of acids minus the base which they find in the blood, and return that base to the body as bicarbonate. I should like to present the older concept of the mechanisms of base recovery and follow this with Pitts' (17, 18) more recent views. Neutral salts of weak buffer acids entering the tubules in the filtrate are transformed into acid salts, and the base is restored to the plasma as bicarbonate. Figure 4 illustrates older well-known concepts, the first being the carbonic acid filtration theory and the second necessitating ammonium carbonate filtration for its explanation. Neither is consistent with current investigative findings. For example, disodium phosphate reacts with carbonic acid to form sodium bicarbonate and monosodium phosphate. The sodium bicarbonate is reabsorbed and the filtrate (with an original pH of 7.4, the same as that of plasma) is converted to a urine as acid as pH 4.5. The amount of base thus recovered is about 10 to

30 mEq. in twenty-four hours; and the average person excretes about 100 to 300 ml. of 0.1 N titratable acid, largely monobasic phosphate.

The kidney is limited in the amount of free sulfuric and hydrochloric acid it can eliminate. Such strong acids must be excreted fully neutralized. The kidney accomplishes this by combining them with ammonium ions, thus conserving the sodium ions (Fig. 4). For example, sodium sulfate or chloride arriving in the tubules, reacts with ammonium carbonate, producing sodium bicarbonate and ammonium sulfate. Sodium bicarbonate is reabsorbed. The amount of base thus recovered in twenty-four hours is about 30 to 50 mEq.; and the average person excretes 300 to 500 ml. of 0.1 N acid per day, neutralized with ammonia.

Ammonia synthesis is a function of the distal tubule, and glutamine and other amino acids are the true precursors (19). To determine the amount of base



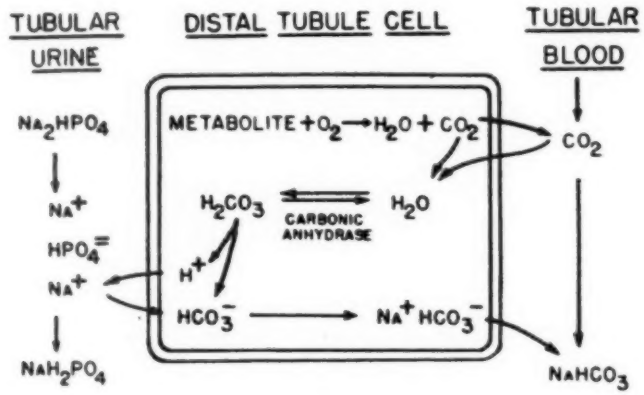
Relationship between rate of ammonia excretion and urine pH (Pitts)

FIG. 5. (Reproduced with permission from Pitts (18))

conserved in converting an alkaline filtrate to an acid urine, one titrates the urine back to pH 7.4 with sodium hydroxide. The resulting value represents the titratable acidity. Henderson and Palmer (20) have termed the sum of titratable acid and ammonia excretion, the total renal defense of the bicarbonate reserve. If acid production in body metabolism does not exceed the capacity of these mechanisms, plasma bicarbonate concentration remains at 25 to 27 mEq./liter.

Both titratable acid secretion and ammonia secretion in the distal tubule restore base to the extracellular fluid, mole for mole, as bicarbonate. As urine pH falls to acid levels the rate of ammonia secretion rises and hence the rate of ammonia secretion must be related in some way to titratable acid secretion (16, 17). Secretion of ammonia is best explained as the diffusion of ammonia into the acidified contents of the lumen of the distal tubule. Here the ammonia ions combine with hydrogen ions to form ammonium ions. Thus the primary

event in the excretion of an ammonium ion is the secretion of a hydrogen ion. Figure 5, reproduced from Pitts (18), illustrates the tubular treatment of salts of strong acids. Sodium chloride enters the filtrate and hydrogen ion is exchanged for sodium across the luminal margin; thus one sodium ion is recovered and the result is one hydrogen and one chloride ion in the filtrate. This acid is neutralized by an ammonium ion, forming ammonium chloride for excretion in the urine. The exchange of hydrogen ions for sodium ions could occur to only a limited extent if the tubular urine contained only salts of strong acids, *e.g.*, sodium chloride or sulfate. The increased concentration of hydrogen ion in the urine would block appreciable transfer, but ammonia secreted into the urine neutralizes this acid by binding hydrogen ions as ammonium ions, thus allowing the exchange of hydrogen ions for base. Each ammonium molecule secreted into the urine binds one hydrogen ion and allows one sodium ion to be reabsorbed. Urine pH must in part govern the rate of diffusion of free ammonia into the tubular urine.



Cellular mechanisms concerned with acidification of urine (Pitts)

FIG. 6. (Reproduced with permission from Pitts (18))

There is general agreement that the acidification of the urine by the distal tubular mechanism is a process of ion exchange rather than a direct secretion of acid (16, 17) (Fig. 6). The distal tubular cell is exposed on one side to the tubular blood and on the opposite side to the tubular urine. Its own metabolic activity and its constant exposure to capillary blood give it a continuous supply of carbon dioxide. The cell has a high content of carbonic anhydrase and hence, can form the dissolved gas into carbonic acid. Carbonic acid, dissociated to hydrogen ion and bicarbonate, allows the exchange across the luminal margin of the cell of hydrogen ions for sodium ions. The sodium with an equivalent amount of bicarbonate returns to the renal venous blood. The hydrogen ions, with the remaining anions, are excreted in the urine as titratable acid. This mechanism serves well with weak buffer acid such as phosphate, or with medium buffer acids such as beta-hydroxybutyrate and aceto-acetate. The base saved from sodium chloride and sodium sulfate, however, requires prompt neutralization by ammonia, because of the strong acids (sulfuric and hydrochloric) which are formed.

PECULIARITIES OF FLUID AND ELECTROLYTE PROBLEMS IN THE AGED

The foregoing has been a presentation of the normal mechanisms employed by the kidney in regulating fluid and electrolyte balance. It is through an understanding of the physiologic mechanisms by which the kidney maintains constancy of the volumes and concentrations of body water that one can comprehend the modifications in body fluids that the kidneys make in both renal and nonrenal diseases (21—26). The functional capacity of the kidney is compromised in varying degrees with the process of aging and hence it becomes important, first to know the normal mechanisms of regulation, and second the modifications imposed by loss of functional capacity of the kidney. The management of fluid and electrolyte problems in the aged requires that one be aware of the renal changes that accompany the aging process.

A sufficient number of studies of the glomerular filtration rate have been made in aged patients to show that the rate declines with increasing age. Davies and Shock (27) have shown that the average inulin clearance declined from 122.8 to 65.3 ml. per min. per 1.73 sq. M. of body surface, between the ages of 20 and 90 years. This represents a fall in glomerular filtration rate of 46 per cent. The subjects were free of any historical or physical stigmata of renal disease, heart disease or hypertension. Olbrich (28) and his collaborators compared inulin clearance in 10 subjects, aged 65 to 80, with normal diastolic pressure, and in 16 subjects, aged 69 to 87, with high diastolic pressure. The average glomerular filtration rate for the group with normal diastolic pressure was 92.1 ml./sq. M./min. The value for the subjects with high diastolic pressure was 76.5 ml./sq. M./min. The blood urea nitrogen level may reflect impaired glomerular filtration, as shown by the observation that there is a gradual rise in the blood urea nitrogen value from the ages of 40 to 89 years.

Thus it seems probable that with impairment of the glomerular filtration rate, one must assume a smaller volume of filtrate delivered to the tubules, when considering tubular treatment of the filtrate in this age group.

The aging process also imposes changes in tubular function. The proximal tubule is responsible in greatest part for the reduction in volume of the filtrate. One of the primary tubular activities is the resorption of water from the filtrate; hence the specific gravity of the urine provides a rough estimate of the effectiveness of tubular water resorption. Specific gravity determinations are reliable only in the presence of reduced water intake, since the specific gravity varies so widely according to differences in water intake. Lewis and Alving (29) showed that the specific gravity did not decline below 1.026 before the age of 65 but, above this age, values below 1.026 were obtained in most of their cases. This suggests that tubular ability to recover water from the glomerular filtrate is somewhat compromised.

There are two very good studies illustrating the decline in tubular function more precisely, by giving clear-cut evidence that the excretory capacity of the renal tubules is decreased. These studies have shown that the average Diodrast T_m declined from 54.6 to 30.8 ml. of iodine per min. per 1.73 sq. M. between the ages of 20 and 90 years, representing a reduction of 43.5 per cent; another study

showed the Diodrast T_m in 10 aged males with normal diastolic pressures to be 36.0 ml./1.73 sq. M./min., whereas the value for 16 males and females aged 69 to 87 with high diastolic pressures was 25.5 ml./1.73 sq. M./min. Miller, McDonald and Shock (30) studied the tubular reabsorption capacity for glucose in patients in the geriatric category, who had no signs of cardiovascular renal disease or of diabetes. The glucose T_m declined from 328 to 223 ml. per 1.73 sq. M./min. between the ages of 30 and 90 years. The blood flow through the kidney in the aged has also been shown to decrease. Davies and Shock (27) demonstrated a decline in the effective renal plasma flow amounting to 53 per cent, between the ages of 20 and 90 years. Olbrich (28) in his study showed that patients with an increased diastolic pressure showed a greater decrease in effective renal plasma flow. The renal vascular resistance has been shown to be as capable of responding to vasodilators as the vessels of younger kidneys, contrary to what one would expect. The available evidence suggests, however, that the principal factor involved in the decline of renal function is that of vascular change. This comprises not only anatomic narrowing but a persistent vasoconstriction. Thus, there is a considerable body of evidence that with increasing age there is gradual decline in kidney function, as indicated by reduced effective plasma flow, decline in glomerular filtration and a reduction in both excretory and reabsorptive T_m.

With the foregoing changes one would predict that the ability to regulate acid-base balance in the aged patient would be also somewhat compromised. Acid-base equilibrium is effected by virtue of the renal function of excreting the excess acid or alkali. Shock and Yiengst (31, 32) have illustrated that there is a statistically significant reduction in the pH of the serum in resting states. We should be aware that although the acid-base equilibrium of the blood can be maintained within normal limits in the aged under basal or optimum conditions, the imposition of the stress of disease brings out the limitations of the aged. Young adults to whom acidifying or alkalinizing substances are administered experience a temporary shift in acid-base equilibrium but recover in from eight to ten hours. The aged, however, have a much slower rate of recovery following the oral administration of equivalent amounts of these substances (32, 33). This study illustrates the impairment of the ionic exchange mechanism discussed in the first part of this paper, which constitutes the renal mechanism for the recovery or rejection of base, according to homeostatic dictates.

The kidney constitutes the main defender of the constancy of the internal environment in regard to volume concentration, composition and pH. Continuity of life depends upon the integration of various systems of the body and how effectively they can maintain a stable cellular environment throughout the body. The aged patient lives in narrower homeostatic balance than does the younger patient. A considerable factor in this narrow balance is the impairment of renal function; the kidneys may serve satisfactorily in the absence of stressful disease, but break down rapidly and more completely when disease develops. It is by a realization of the functional decline in renal ability that one can more accurately diagnose and direct therapy in the aged patient.

The aged diabetic patient with ketosis responds more slowly to acid stress than does the younger diabetic. The tubular cells increase their excretion of

titratable acid and ammonia to recover base, sodium, potassium and calcium used in the neutralization of ketone bodies. In the aged patient with relative or absolute renal insufficiency, the tubular ability to recover base is impaired or loaded to capacity early in ketosis. His acidosis, therefore, is not as well compensated; and the dehydration consequent to decreased fluid intake and vomiting produces more rapidly a decline in plasma volume, hypotension, and a further decrease in the already reduced glomerular filtration rate. Thus therapy is more urgent in the older than in the younger patient and prophylaxis becomes all the more important.

The aged patient with congestive heart failure already has a reduction in his glomerular filtration rate, before congestive heart failure occurs. With a further decline in renal blood flow consequent to congestive failure, the total volume of filtrate may be strikingly low. The differing manifestations of congestive failure in the aged are surely due in great part to variation in the responsiveness of his kidney.

The older patient who has been subjected to trauma, either accidental or surgical, is not as able to combat the resulting disturbed metabolism as is the younger patient. Following injury, he may not conserve sodium and water as well and his rate of nitrogen and potassium excretion is commonly increased above the pretrauma excretion level. The catabolic phase of metabolism following trauma is apt to be prolonged in the aged patient because of his impaired renal function, and he may continue to retain as much sodium as possible but waste nitrogen and potassium beyond the usual five to seven days following trauma. Normally, one would expect the patient on the fifth to seventh day to store nitrogen and potassium, but commonly this does not occur in the aged.

CONCLUSION

A thorough knowledge of the mechanisms of renal regulation of fluid and electrolyte balance in younger patients and the limitation imposed by the aging process in older patients, is essential to proper diagnosis and therapy of fluid and electrolyte problems in the geriatric patient.

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MODERN REHABILITATION FOLLOWING CEREBRAL HEMORRHAGE OR THROMBOSIS*

HAROLD LEFKOE, M.D.† AND A. A. MARTUCCI, M.D.‡

From the Department of Physical Medicine and Rehabilitation at the Philadelphia General Hospital, Philadelphia, Pa.

I. INTRODUCTION

Cerebral palsy has received most of its prominence with respect to its treatment in infants. However, it has long been known that infants with cerebral palsy grow into maturity and become problems as adults; at the other extreme we have seen a youngster of three years with a stroke. It is obvious that the problems of cerebral palsy cannot be limited to children, and in our cerebral palsy clinic at the Philadelphia General Hospital the victims of this disease range in age from the youngest infants to the oldest adults. We cannot and do not draw a distinction between patients who have lost certain abilities due to a stroke after the age of 40, and those who have suffered the same or similar losses in childhood. The adult who has a stroke with a residual hemiplegia is as much a cerebral palsy problem to us as is the child with the same lesion. Most of the patients whose data are presented here have been seen in the Department of Physical Medicine and Rehabilitation of the Philadelphia General Hospital (a large city-owned, charitable institution), and the remainder have been seen in private practice.

This paper will not concern itself with the details of the underlying reasons for a stroke, or the diagnosis and pathology, in general. In most instances these are recorded before the patient is referred to us for treatment. It is worthy of note that cerebral palsy, occurring so frequently while the patient is in bed and even asleep, is not usually associated with high blood pressure and failure of the walls of a cerebral vessel resulting in hemorrhage; it is more often associated with sluggish blood flow and thrombosis. The onset of a stroke while the patient is excited, frightened, laboring, or upset—usually considered to be causes—is rare, in our experience.

It is well to define terms at the outset. Lexicographically, the term "paralysis" should be limited to a loss of function. This loss may be either motor or sensory. Unfortunately, paralysis is often subdivided into partial and complete. Actually, "paralysis" must be complete. So-called "incomplete paralysis" is "paresis." "Hemiparalysis" is a paralysis of one side of the body, and has as its counterpart "hemiplegia." "Hemiparesis" is paresis affecting one side of the body.

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† Orthopedic Surgeon at the Albert Einstein Medical Center, and at St. Joseph's Hospital, Philadelphia.

‡ Chief Physiatrist at the Philadelphia General Hospital, Episcopal Hospital, and Stetson Hospital in Philadelphia, and at Abington Memorial Hospital, Abington, Pa.

Hemiplegia or hemiparesis is present when the patient recovers from his acute episode, whether it be due to hemorrhage or to thrombosis. Clinical experience has shown that the extent of the paralysis immediately following the cerebrovascular accident is no criterion of the degree of improvement to be expected. Of more importance in estimating the amount of future recovery is the knowledge of a pre-existing stroke on the same side, or the indications of a pre-existing stroke on the opposite side. In the atonic type, wherein the initially lost reflexes never return and the musculature remains flaccid, the prognosis is usually poor.

The abuse of bed rest has been frequently stressed. Bed rest as the treatment for the muscular involvement following a cerebral accident has been so overdone that at times patients have been seen who are still confined to bed several years after the occurrence of the stroke. Now, however, we are seeing patients within three or four days of the major episode. Bed rest is necessary during complete or partial unconsciousness, and while the patients are still febrile; but we are desirous of seeing patients up out of bed as soon as these conditions (if they existed) are no longer present.

II. SCREENING

Every patient is presented at our Cerebral Palsy Conference for screening before treatment is undertaken. A detailed history has been taken and a physical examination made prior to his appearance. The intern presents the case before the Conference, which consists of the physiatrist (together with the physical therapy and occupational therapy technicians), the neurologist and neurosurgeon, the orthopedist, the social service worker, the speech therapist, nurses, and any other interested personnel.

The screening is of utmost importance to us because of the value of accurate diagnosis as a factor in making a prognosis. With the prognosis as a criterion, we can eliminate from the training and rehabilitation program cases which do not promise improvement in proportion to the use of the scarce personnel. The obviously senile and psychotic patients, who would have little use for the benefits derived from a long and intensive rehabilitation program, are usually eliminated. The patient who has no place in society once he leaves the hospital unless he can be made completely self-sustaining, must be handled with a different approach than is the individual who has a home and family anxious to receive him. The patient with other medical problems of major importance, such as a proved neoplasm, or true malignant hypertension, may not be afforded the intensive, prolonged rehabilitation which his stroke per se may require.

In deciding on the type of rehabilitation program to be instituted we pay attention not only to the patient himself and his complete and detailed physical examination but, particularly, to his blood pressure and to his cardiac status. Cardiac decompensation is a much greater deterrent to a program of rehabilitation than is hypertension, when it comes to estimating the amount and intensity of treatment to be instituted. Such factors are also of importance as we consider not only the extent of the motor and sensory involvement, but also the problems of language, the intellectual capabilities of the patient, the need for occupational

therapy to help him return to his old occupation, or the need for vocational therapy to teach him a new occupation.

III. TREATMENT

Language impairment has been found to be an important point of attack. Very frequently improvement in this respect results in much greater cooperation on the part of the patient, who thus has a tangible result of therapy presented to him. The simple method of communication by hand signs devised by Dr. Hamilton Cameron, requiring only one hand, allows the individual suffering from a stroke and acutely aware of his own inadequacies, to communicate with others rapidly; this accomplishment gives him a marked feeling of security.

The next objective is the teaching of selfcare. Here again the mental stimulation which the patient receives when he realizes that he is no longer completely dependent, enhances his cooperation in furthering his own improvement, and is at the same time of no small assistance to the nursing personnel.

The use of heat in its various forms in order to cause local vasodilatation has long been recognized to be of advantage. Infra-red radiation, diathermy in various forms, hot air, paraffin, and the whirlpool all have their place. We stress the importance of following heat treatment by massage. We decry the frequent use of heat alone, without the circulatory benefits from massage immediately following.

Electrical stimulation, which induces contraction of muscle fibers with resultant improvement in lymphatic and venous return, as well as the proved retardation of muscle atrophy and the recognized lessening of interstitial fibrosis, is an important part of the program. In addition, sinusoidal stimulation frequently jumps the hurdle in cases in which coordination has been lost between brain and muscle; such coordination is very difficult to restore, particularly with respect to the quadriceps and deltoid groups of muscles.

When the muscle contracts of its own accord, active re-education of functional muscle groups can be begun. Simple active motions are rapidly enhanced by guided active motions, and these progress to exercises against resistance.

Mat exercises are used frequently. We know that spasticity of muscles in the upper extremity is influenced primarily by the position of the arm. For example, on examination of a hemiplegic patient with the arm at the side, the flexors are found to be hypertonic. The arm is elevated to 90 degrees and the extensors predominate. This is, of course, the position of the quadruped. On the mat, in this position, the patient can actively perform with ease movements which he is unable to perform in the erect position. Giving him the opportunity to go through these additional movements enhances his confidence in himself, and at the same time obtains all of the benefits of active motions.

Theoretical positions of the joints are ignored, because of the scarcity of nursing personnel. Gross footdrop from the weight of covers is prevented. Otherwise contractures are prevented by putting all joints through a full range of motion at least once a day.

Gait training is stressed because of the importance of ambulation in self-care.

Experience over the years has proved that the techniques of physical medicine accomplish far more than drugs and surgery in the re-establishment of ambulation. The problem is not basically a loss of power, such as seen in poliomyelitis—it is an inability to direct properly the power which is present. One of my very earliest recollections is the sight of a freshly beheaded chicken running and fluttering around a backyard. Here indeed was a complete loss of all directional influence from the upper centers, but certainly a tremendous amount of muscle power was being used. In the same sense, paralysis may exist because of a cortical lesion, yet many spontaneous reflex movements may be retained in the extremities.

In our treatment of this part of the problem we have adopted wholeheartedly the "pattern movements" of Temple Fay, and have been very pleased with the results obtained. The pattern-movement technique is based on the simultaneous and sequential responses of spinal automatism—the defense reflexes seen experimentally after section of the upper cervical spine, or in the "decerebrate animal" after the pyramidal pathways of the brain stem are cut in the midbrain. In Fay's technique, these reflexes are used beneficially to strengthen muscles, relax antagonistic muscle groups, and coordinate muscle tone.

Patients are started on the homolateral pattern movements, performed prone, and reverting to the amphibian pattern. When these are well done, the patient is graduated to the "cross-pattern" movements of the reptilian type. These are ultimately the basis for the true coordinated patterns of walking. A patient with a right hemiplegia, can voluntarily direct his left upper extremity to move (because there is no change on the right side of his brain), and that movement can initiate a cross-reflex or pattern movement—resulting in movement of the right lower extremity.

A board with the footsteps marked, and with strips of molding placed to guide the feet into a position of external rotation of the lower extremity, is of considerable value. With the feet turned out at 30 degrees, the adductors are unlocked, and adductor spasm is no longer present. It is to be noted that the orthopedic concept of proper walking, with the toes pointing straight ahead, is not upset; it is simply allowed to give way before the problem of greater importance, that of adductor muscle spasm, which is relaxed reflexly by the external rotation of the lower extremities to the 30-degree point. We try to get all the patients to wear shoes rather than bedroom slippers, but this is sometimes difficult in a hospital where clothing is routinely sent home with the family. When indicated, orthopedic corrections are utilized.

Vocational training has been established in our new department, and in it we try to assist the patient to become self-supporting. He may have to be taught a more sedentary job than the one he had before his stroke. He may no longer be able to walk up flight after flight of stairs as a collector, and must now be taught something entirely new. The woman is given practice in home economics. She learns how to work around the stove once again, how to work around the refrigerator, and how to handle the dishes—all capacities which she has lost as a result of her cerebral catastrophe.

IV. SUMMARY

A program of rehabilitation has been presented, which is at present in actual use, and which has served to improve both the prognosis and the speed of improvement in patients following a stroke.

V. CONCLUSION

Recovery from the acute catastrophe of a stroke is not the end of modern medical responsibility. A new vista in rehabilitation has been opened up and, under the intensive regimen of physical medicine, treatment is now continued until the disabled person has been trained to live and to work at the optimum level of his remaining capacities. Inasmuch as stroke is a frequent, if not the most frequent, cause of chronic disability in the aged, the importance of this work is obvious.

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THE EARLY RECOGNITION OF BRONCHOGENIC CARCINOMA

ALTON OCHSNER, M.D., PAUL T. DECAMP, M.D. AND C. J. RAY, M.D.

From the Department of Surgery, School of Medicine, Tulane University and the Ochsner Clinic, New Orleans, La.

Although early diagnosis is desirable in practically all illnesses, it is of utmost importance in malignant neoplastic disease. Cancer is primarily a disease of older persons. As a result of better medical care and increased longevity, the older age group in our population has increased, and thus the total number of cancer cases has steadily multiplied in spite of efforts to control and correct precancerous lesions. Of all the cancers of the body, bronchogenic carcinoma is increasing more rapidly than any other. In 1912, Adler (1) was able to collect only 374 cases of cancer of the lung and stated, "On one point, however, there is complete consensus of opinion and that is that primary malignant neoplasms of the lung are among the rarest form of disease." In the brief span of forty years, primary cancer of the bronchus has become one of the most frequent malignant lesions in general, and is the most frequent malignant lesion in men. In the ten-year period from 1938 to 1948, the deaths from bronchogenic carcinoma in the United States increased 144 per cent (from 6,732 in 1938 to 16,450 in 1948). During this same period, deaths from all types of cancer increased 31 per cent (from 149,214 in 1938 to 195,594 in 1948). From 1920 to 1948, the death rate from bronchogenic carcinoma in the United States increased over ten times (1.1 per hundred thousand population in 1920 to 11.3 per hundred thousand in 1948). The proportion of deaths from cancer of the lung to all cancer deaths has also increased throughout the years. In 1920, lung cancer represented 1.1 per cent of all cancer deaths; in 1930, 2.2 per cent; and in 1948, 8.3 per cent. We have the temerity to predict that if the increase in the incidence of bronchogenic carcinoma continues proportionately as it has up to the present time, in 1970 it will represent 18 per cent of all cancers, or almost 1 in 5. It is obvious, therefore, that the early recognition of bronchogenic carcinoma is imperative, provided, of course, that something can be accomplished if such recognition is made early. That bronchogenic carcinoma is a disease primarily of older persons is illustrated by our experience in 1,122 cases, of which 38 per cent were in the sixth decade and 40 per cent in the seventh decade; only approximately one-fourth were less than 50 years of age. Overholt (2) and others (3, 4) have shown that the resectability of lung cancer can approach 100 per cent if the diagnosis is made and treatment instituted early, even before the patient has symptoms.

In this consideration, one should define what is meant by early recognition. The desideratum, of course, is recognition of the condition early in the course of the disease, which does not necessarily mean shortly after the onset of symptoms. There is undoubtedly a great deal of variation in the rate of growth of bronchogenic carcinoma, since it has been our experience that not infrequently patients who have had symptoms for a considerable period of time have operable lesions

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and, conversely, patients with symptoms of short duration may have inoperable lesions. Nevertheless, it is desirable that a diagnosis be made while the lesion is still limited to the lung. Unfortunately, in all of our series there was a delay of 8.7 months from the onset of the first symptom until definitive therapy was instituted; but the delay was shorter (7.5 months) in the cases which were not resectable than in those which were resectable (10.5 months). This apparent paradox indicates that although a longer period elapsed between the onset of symptoms and the institution of definitive therapy in the latter group, the lesions were resectable because they were growing more slowly than those in the former group. Of course, delay in diagnosis is deplorable because undoubtedly, had the condition been suspected and the diagnosis made within a few weeks or a few months after the onset of symptoms instead of after 7.5 months, resection would have been possible in many of the nonresectable cases. Overholt (2) has shown that in the cases of bronchogenic carcinoma picked up by mass roentgenographic surveys in individuals with no symptoms, the resectability incidence is 100 per cent, and in 75 per cent of these cases the lesion is limited to the lung. One would hope, therefore, that the curability rate in these cases would be well above 50 per cent and probably in the neighborhood of 75 per cent. In contradistinction to these results reported by Overholt (2) are the results which we (5) have obtained in 1,122 cases of bronchogenic carcinoma, all of which, with the exception of 6, had symptoms referable to their cancer. Of this group, 483 (43 per cent) were obviously inoperable when first seen and 639 (57 per cent) were considered operable. In the group considered operable, 57 patients (9 per cent) refused surgery or went elsewhere; 582 (52 per cent of the entire group) were explored, and in 210 (36 per cent) of these the carcinoma was found to be nonresectable because of the extent of the disease. Resection was performed in 372 patients (33 per cent of the entire group), and 196 of these (80 per cent, and 26 per cent of the entire group) survived operation. It is thus seen that, in contrast to the group of cases reported by Overholt (2) in which there were no symptoms and in which bronchogenic carcinoma was picked up accidentally by routine chest roentgenography and in which all were resected, only 33 per cent of our cases in which symptoms were present were resectable. Although in 75 per cent of Overholt's (2) symptomless cases the lesion was limited to the lung, in only 25 per cent of our cases with symptoms, was the lesion limited to the lung. It must be emphasized that since our earliest experience with the treatment of bronchogenic carcinoma, we have advocated and practiced palliative resection—a philosophy which has not been shared by many other thoracic surgeons. Although there are a few general surgeons who would hesitate to resect a gastric lesion even though there were metastases to the liver, or to resect a lesion of the colon with metastases to the liver, there are many thoracic surgeons who believe that once the neoplastic lesion has spread beyond the lung, resection is not indicated. Our resectability incidence of 33 per cent for the entire group represents the results of an aggressive form of therapy which although originally not generally accepted is now becoming more generally adopted, and we believe that in time most thoracic surgeons will perform palliative resections more fre-

quently than they have in the past. It is the consensus of most thoracic surgeons that evidence of recurrent or phrenic nerve paralysis is an indication of inoperability. Although involvement of these nerves is evidence that the lesion has spread beyond the lung, it does not mean that the lesion cannot be removed and the salvage rate in such patients increased. In 7 per cent of our patients in whom a resection was performed, there was evidence of recurrent laryngeal recurrent paralysis. A much larger number of individuals with recurrent laryngeal paralysis were subjected to thoracic exploration and the lesion found to be nonresectable. On the other hand, if the 7 per cent of resected cases in which there was recurrent laryngeal paralysis had been denied the advantages of exploration because of acceptance of recurrent or phrenic nerve paralysis as an evidence of inoperability, their salvage rate would not have been increased.

The diagnosis of bronchogenic carcinoma is generally not difficult to make, if a physician will only think of the possibility of its existence and take steps either to prove or to disprove it as a diagnostic possibility. Because of the tremendous increase in the incidence of this lesion, it is imperative that every physician consider the possibility of bronchogenic carcinoma in every man past 40 years of age who has unexplained thoracic discomfort and who has been a heavy cigarette smoker. As repeatedly emphasized in previous publications, we (6) are of the conviction that the tremendous and unprecedented increase in the incidence of bronchogenic carcinoma in recent years is due to the carcinogenic effect of tobacco. There is a distinct parallellism between the sale of cigarettes and the incidence of bronchogenic carcinoma. The annual production of cigarettes per capita, which includes men, women, children, and babes in arms, increased from 46.3 in 1903 to 2,541 in 1948. Excluded from the latter figure are those produced for foreign consumption. Because there is a definite lag in the development of cancer after the use of carcinogenic agents, the effect of cigarette smoking is delayed for approximately twenty years after the onset of smoking. From 1920 to 1930, the annual number of cigarettes per capita increased from 480 to 930 (approximately 2 times). In the decade about twenty years later, that is from 1938 to 1948, during which time the carcinogenic effect of smoking in the earlier decade could have become evident, the number of bronchogenic carcinomas per one hundred thousand population increased from 4.2 to 11.3. In the eighteen years from 1930 to 1948, the annual number of cigarettes per capita consumed increased from 930 to 2,541 (2.6 times) and if there is a causal relationship between cigarette smoking and bronchogenic carcinoma, the deaths per hundred thousand population from this cause may be expected to increase from 11.3 at the present time to 29.4 by 1970. Because of the likely causal relationship between cigarette smoking and bronchogenic carcinoma, it is our belief that all men who have smoked a package of cigarettes a day for twenty years or longer are likely candidates for bronchogenic carcinoma and, if persistent respiratory symptoms develop, this diagnosis is likely until it has been definitely disproved.

Bronchogenic carcinoma has been, since its early recognition, primarily a disease of the male sex. In our 1,122 cases, 89 per cent were in males and only 11 per cent in females. Whereas it is the contention of Graham (7) that the incidence

of bronchogenic carcinoma will increase in females because smoking is becoming increasingly more prevalent among women, it is our belief that although cigarette smoking does exert a carcinogenic effect, the mucous membrane of women is relatively immune to this effect and that the bronchial mucous membrane of men is more susceptible to malignant change than that of women.

Because of the desirability of making a diagnosis of bronchogenic carcinoma even before symptoms present themselves, it is recommended that all men past 40 years of age who have been heavy smokers for a number of years undergo routine chest roentgenography at least every six months and preferably every three months, so that if a lung cancer does develop, it can be detected at a time when the lesion is still limited to the lung and even before it produces symptoms.

The symptoms in lung cancer are usually those of a complication. If the lesion is large enough to produce irritation of the bronchus, a cough is usually present. However, since most smokers have a so-called cigarette cough, this is likely to be disregarded. On the other hand, a cough which changes in character should be looked upon as significant and demands investigation. Hemoptysis indicates ulceration and is always a manifestation of serious significance and should never be disregarded. Occasionally, thoracic discomfort is complained of, which is apparently due to an increase in growth of the tumor. Only when the neoplasm has extended beyond the lung to involve the parietes or the mediastinum, is pain complained of. Such a manifestation is an indication of extensive disease. Wheezing may be an early manifestation. It is of significance primarily in individuals who previously had no wheezing and does not apply to an individual who has been an asthmatic most, if not all, his life. Wheezing means bronchial obstruction and, when it occurs in a man past 40 who previously has had no evidence of such a condition, it usually means bronchogenic carcinoma.

As a result of obstruction of the bronchus from the bronchogenic neoplasm, stasis distal to the obstruction, associated with atelectasis, results in pneumonitis of an atypical variety. Unfortunately, approximately five years ago considerable attention was paid to viral pneumonia, which was so prevalent among the young military personnel in the United States. Because viral pneumonia ran an atypical course, it was designated as atypical pneumonia and the profession has come to think of viral pneumonia and atypical pneumonia as being synonymous. This is unfortunate, because all too frequently an atypical pneumonia is considered *a priori* to be viral pneumonia. It is our belief that although there are cases of viral pneumonia, they are probably rarer than is bronchogenic carcinoma in men past 40 years of age, because of the great incidence of bronchogenic neoplastic disease in individuals who have been heavy smokers. Although there has been a decrease in the delay in making a diagnosis and instituting a definitive therapy throughout the years as shown by our cases, in the past year the delay has been actually longer and the resectability has increased. Up to 1941, the delay was 9.9 months; from 1942 to 1946, 1.6 months; and from 1947 to 1951, 8 months. The longer delay in the past year is undoubtedly due to the fact that there are an increasing number of patients in whom a diagnosis of viral pneumonia is made by their physicians and who are treated for weeks or even months by antibiotic

therapy. There is some slight improvement in the beginning because of control of the secondary infection, but this is later followed by progression of the disease, at which time bronchogenic carcinoma is suspected. Had the physician accepted the dictum that all men past 40 years of age, particularly those who have smoked heavily and who have an unexplained thoracic discomfort, must be suspected of having bronchogenic carcinoma, and had he instituted measures to confirm or exclude this diagnosis, the dangerous delay could have been avoided. This does not mean, of course, that all patients with such symptoms should be subjected to exploratory thoracotomy. If, on the other hand, under a regimen of conservative therapy, the entire clinical picture does not subside or disappear completely within a period of a few weeks, the diagnosis of viral pneumonia must be abandoned and that of bronchogenic carcinoma considered.

Of all the various diagnostic procedures, roentgenography is the most important because in most instances it is possible to detect the tumor by this means, even before symptoms are produced. A small lesion which incompletely obstructs the bronchus, even though it may not be large enough to produce a shadow on the roentgenographic film, can produce obstructive emphysema; air can get beyond the neoplasm into the lung distally during inspiration when the bronchus is dilated, but during expiration when the bronchus normally contracts, the air cannot get beyond the tumor and remains trapped. A localized obstructive emphysema, therefore, is of significance and must be investigated to exclude the possibility of bronchogenic neoplasm. If the tumor is large enough to infiltrate and to cast a shadow, it is of diagnostic importance and must be suspected in all men past 40 years of age. In those instances in which the bronchus becomes occluded by the tumor, not permitting air to enter or to leave the lobe supplied by the involved bronchus, absorption of air distal to the occlusion occurs with production of atelectasis. A telltale evidence of atelectasis, namely, displacement of the mediastinum toward the affected side and elevation of the diaphragm on that side, in addition to the shadow produced by the airless lung, is of significance. If this condition is found in a man past 40 who has been a smoker, it justifies the presumptive diagnosis of bronchogenic carcinoma. Bronchography is of value in certain cases of bronchogenic carcinoma, particularly those in which the lesion is located in areas which are not visible bronchoscopically because of their location either in the upper lobe or in the periphery. In 56 per cent of our resected cases, the lesion was located in the upper-lobe bronchus and in many of these it was not visible bronchoscopically. On the other hand, demonstration of bronchial obstruction following the introduction of Lipiodol is of diagnostic importance. In our series of resected cases, roentgen diagnosis was positive in 83 per cent.

Bronchoscopy is an important diagnostic method and should be carried out in all cases of suspected bronchogenic carcinoma. Unfortunately, however, because of the relatively large number of tumors (56 per cent of our cases) which are located in the upper-lobe bronchi, positive diagnosis by bronchoscopy is possible in only slightly more than one third of the cases (36 per cent).

The most valuable method of making a positive diagnosis of bronchogenic carcinoma (the diagnosis made roentgenologically is always presumptive) is

demonstration of malignant cells in material obtained from the bronchi as a result of either expectoration or bronchial aspiration. Although specimen for specimen, the material obtained by bronchial aspiration gives a higher incidence of correct diagnoses determined by cytologic examination than does sputum, in our series sputum examination, because of the ease with which it can be made and the large number of specimens that can be examined, gave a higher incidence of correct diagnoses than did examination of material obtained by bronchial aspiration. In the cytologic examination of secretions, it is imperative that one have available not only a good tissue pathologist but also one who is trained in cytologic diagnosis. In addition to this, he should be inbued with a desire to spend a great deal of time looking for malignant cells. Unless all of these requirements are satisfied, the incidence of correct diagnosis is not likely to be found. In our series of cases, a correct diagnosis was made preoperatively in 68 per cent.

Thoroscopy has been advocated as a diagnostic measure. We are of the opinion that it is not much value as a diagnostic measure, but is of value as a prognostic procedure. In patients in whom there is suspected extension to the pleura, it is desirable that thoracoscopic examination be made in order to determine whether or not pleural involvement has occurred.

Aspiration biopsy has been advocated and practiced by many. Although it is possible in most, if not all, of the peripherally located lesions to make a positive diagnosis by means of aspiration, we are of the firm conviction that it should not be performed if there is any chance of obtaining a cure from operative extirpation, because we fear the implantation of tumor cells along the site of the aspirating needle when it is withdrawn. We use aspiration biopsy only in those cases in which the condition is usually inoperable, but in which we want to prove the diagnosis.

In approximately 20 per cent of patients with proved bronchogenic carcinoma, it is impossible to make a positive diagnosis before thoracic exploration. Although previously, thoracic exploration was thought not to be advisable or permissible in bronchogenic carcinoma, we are convinced, and it is probably the consensus of most thoracic surgeons, that thoracic exploration is a justifiable method of diagnosis. The individual who clinically is suspected of having bronchogenic carcinoma, but in whom it is impossible to prove its existence, should be given the advantage of a thoracic exploration. A solitary nodule in the lung field, regardless of how benign it may appear, should be watched because of the possibility that it may be a malignant neoplasm. If lung abscess, which is a frequent complication of bronchogenic carcinoma because of infection by breakdown of the tumor or suppuration distal to the obstructing mass, occurs in a man past 40, it must be considered as being due to bronchogenic carcinoma until proved otherwise. At the time of thoracic exploration, one of several measures may be resorted to in order to make a diagnosis. If the lesion is located peripherally, a simple biopsy is justifiable. Generally, we prefer excision biopsy, either by wedge resection, segmental resection, or lobectomy. Immediate frozen-section examination will, almost without exception, provide the correct diagnosis.

If bronchogenic carcinoma is found, immediate pneumonectomy together with removal of all the mediastinal lymph nodes should be performed. The importance of early diagnosis in bronchogenic carcinoma is illustrated by the statistics of Overholt and Schmidt (8), who stressed the importance of the silent phase of bronchogenic carcinoma, during which time there are few or no symptoms. In a series of 65 cases in which shadows in the lung were found on roentgenography, 19 were malignant and 39 were benign. Of the 19 malignant tumors, 79 per cent were resectable. Subsequently, Overholt (2) reported 145 cases in which pulmonary shadows were detected during chest surveys; in 51 the lesions were neoplastic and in 35, malignant. He states, "If the patient waits for symptoms and if the delays that follow in the average cases are added to this time lost, approximately 90 per cent of the lesions have by that time extended to structures outside the lung. The possibility of cure, therefore, is limited to a meager 10 per cent in the symptomatic stage of the disease. To explore and carry out excisional treatment during the silent phase will set treatment ahead by months or years. In our clinic, when prompt treatment has followed discovery of cancer by survey, all lesions have been resectable and in 75 per cent have shown no evidence of lymphatic spread. All patients in the group are still living." In contradistinction to these statistics, in our series (5, 6) of 377 resections, the operation was performed as a palliative procedure in 74 per cent. In other words, the lesion had extended beyond the lung at the time of the operation. In 1,122 proved cases of bronchogenic carcinoma, 483 (43 per cent) were inoperable when first seen. Of the 639 which were considered to be operable, 582 were explored and 210 (36 per cent) of these were found to be nonresectable. There were 372 which were resected, or 33 per cent of the entire group of cases seen. In only 6 of our patients was the lesion asymptomatic, in contradistinction to the condition in the cases picked up by routine chest surveys in Overholt's (2) series.

In spite of the fact that in three fourths of our cases the lesion had extended beyond the lung and the resection had to be considered a palliative one, the results were worth while, although they left much to be desired. Forty-eight per cent of the patients undergoing resection were alive at the end of six months, 33 per cent were alive at the end of a year, and 15.2 per cent at the end of five years. In contradistinction to this, in a group of cases not resected, no patient lived longer than four years, even though in each instance some type of palliative therapy, such as nitrogen mustard, x-radiation, or a combination of x-radiation and chemotherapy was used. The survival rate in the patients with extensive disease in whom palliative resections were performed was 7.2 per cent at the end of five years, whereas in patients in whom the lesion was grossly limited to the lung it was 32 per cent. It must be emphasized that the patients surviving are considered as all those alive at the end of five years; and those dying, regardless of the cause, are considered as dead of carcinoma. When it is recalled that only 85 per cent of the general population are alive at the end of five years, these statistics are not as bad as they might otherwise seem. On the other hand, as mentioned previously, there is much to be desired, and it is imperative that earlier diagnosis should be made in bronchogenic carcinoma if the mortality rate is to be decreased and the

survival rate increased. Early diagnosis is possible only if the possibility of the presence of bronchogenic carcinoma is considered by the physician. Fortunately, progress has been made. In our series, from the onset of first symptoms until definitive therapy was instituted, up to 1941 there was a delay of 9 months; from 1942 to 1946, this delay was 9.6 months; but from 1947 to 1951, it was 8 months. On the other hand, resectability is not entirely dependent upon the short duration of symptoms, as is also illustrated in our series of cases. Whereas the entire length of symptoms between onset and the institution of definitive therapy was 8.7 months, in the group in which resection was not possible this delay was 7.5 months, but in the group in which resection was performed it was 10.5 months. Although this seems paradoxical, it simply means that with the rapidly growing tumor there was a short duration of symptoms and the tu... ...ecame inoperable and was not resectable, whereas in the slowly growing tumor, even though the symptoms had existed for a longer period of time, the lesion was still resectable.

There was a difference also in delay between the private and the charity cases. The delay in the private cases was 9.3 months, whereas in the charity cases it was 7.5 months. If this delay is broken down into responsibility according to the physician and the patient, it is seen that in all the cases delay due to the patient was 8 months, whereas that due to the physician was 5.5 months. In the charity cases, this division was 3 months and 3.6 months, respectively. This difference may be not as real as it seems, because undoubtedly the indigent patient is not as careful about his symptoms as is the private patient and he is less likely to pay attention to the inaugural symptoms. The delay of 3 months in the charity cases is probably not correct. On the other hand, there was a longer delay on the part of the physician in the private series, as indicated by the fact that the patient delay was 2.6 months whereas the physician delay was 6.2 months. This was undoubtedly due to the fact that the indigent patient is not able to pay for hospitalization for the treatment of his pneumonitis and he is, therefore, referred to the Charity Hospital. On the other hand, the private patient who is able to pay for hospitalization and antibiotics is sent to the hospital and treated for his pneumonitis for weeks and even months before the possibility of an existing bronchogenic tumor is thought of.

It is thus obvious that bronchogenic carcinoma must be thought of more frequently by the medical profession, and it is imperative that a man past 40 years of age who has an unexplained thoracic discomfort, particularly if he has been a heavy smoker, must be considered as having bronchogenic carcinoma until it is proved otherwise. In fact, it is important that bronchogenic carcinoma be conconsidered in all men past 40 who have smoked a package of cigarettes a day for twenty years or more. It is our belief that if the incidence of correct diagnoses of bronchogenic carcinoma is to be increased, routine chest roentgenograms should be made every three to six months of all men past 40 who are heavy smokers. Thus, if and when bronchogenic carcinoma develops, it can be detected at a time when it produces few or no symptoms, because development of symptoms in bronchogenic carcinoma usually means extension beyond the lung.

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DISABILITY OF THE HIP IN OLDER PEOPLE

J. E. M. THOMSON, M.D.

From the Lincoln Orthopedic Clinic, Lincoln, Nebraska

With the marked increase in the number of people of advanced years in our population, we are more frequently confronted with very disabling conditions of the motoskeletal system. A few decades back these were so infrequently observed that when confronted with such a problem we were inclined to brush off the possibility of solution because of the futility of accomplishing a worthwhile result. Therefore many old people with painful hips were relegated to a wheelchair existence for the few years they had left. The usual medical therapy was to convince them that they were but the victims of wear and tear and that the best they could do was to make the best of a bad, painful situation. Analgesics, heat, and hot packs were the palliative measures of choice. The surgical approach to the problem was for the most part so extensive, mutilative, and demanded such long immobilization in plaster of paris casts from the axilla to the toes that it was hazardous, shocking, and culminated in high mortality.

Recently with the interest and pertinent demand for geriatric therapy, the defeatist attitude of the past has given way to an enlightened, new approach to these problems which has put many of these very unhappy sufferers back in circulation as economically physically and mentally productive individuals in community life.

Of the motoskeletal problems of the aged, perhaps the painful hip is the most common and disabling because it ultimately limits and prevents normal locomotion. It comes on so insidiously that it may be very disabling before our aging patient or his physician realizes the seriousness and destructiveness of the condition. It is therefore essential that a historical survey of the patient be made as early as possible.

ETIOLOGY

Among the conditions that contribute to the painful hip syndrome are the arthritides, trauma, congenital anomalies, and systemic disease. To be more specific, the causes are briefly summarized:

1. Arthritides:
   a. Rheumatoid arthritis is a polyarticular progressive disability occurring in early or mid-life which, by the time advanced years have come, has usually been completely compensated. However, occasionally an incomplete ankylosis of an old affected hip will cause intense pain and severe disability.
   b. Hypertrophic arthritis is a polyarticular degenerative condition of no specific etiology which often manifests symptoms of hip pain late in life. However, on viewing the roentgenograms of such a case, the me-

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chanical derangement of joint relationship is so evident that it is not difficult to understand why the patient complains. On the other hand, one may at times see extensive hypertrophic changes with evident loss of articular cartilage on x-ray examination, without the slightest complaint of pain, but there will be marked limitation of motion and a definite limp. When reviewing the history, little of import may be elicited but usually there is the story of an early pyogenic infection, a chronic synovitis, a minor

FIG. 1. Aseptic necrosis of the head of the femur in an elderly patient following a fracture of the neck which was treated by reduction and triflanged nail several years previously. After three years the nail was removed, as the patient thought the pain in the hip might be due to the nail. However, after removal, discomfort continued and ultimately the roentgenogram showed an aseptic necrosis with sequestration of a section of the head. Such a condition is ideal for a prosthesis.

congenital anomaly, an injury such as a slipped femoral epiphysis, a fracture, or a dislocation of the hip.

c. Traumatic arthritis is ultimately a hypertrophic manifestation; therefore no further comment need be made concerning it.

d. Metabolic arthritis must not be forgotten. Gout can occur in the hip as well as in the great toe and is often missed. The seizures are intermittent until extensive degenerative and proliferative changes have occurred in the joint.

2. Aseptic necrosis of the head of the femur (Fig. 1) is a common cause of severe hip disability in older people. It usually follows injury or some interference

with the circulation of the hip. It occasionally occurs years after a fracture of the neck of the femur has completely healed or after a dislocation, and is characterized by an actual dissolution of the articulating head in the acetabulum.

FIG. 2. Coxa malum senilis has much the same appearance as hypertrophic arthritis and many other progressive degenerative conditions which we find on x-ray examination of the painful hips of old people. In this particular case the articular cartilage has been destroyed; the head of the femur has changed and flattened so much that the weight-bearing thrust is far lateral to the normal acetabulum. However, nature has endeavored to help by providing a protruding lip from a hypertrophic spur on the upper lip of the acetabulum.

3. Coxa malum senilis (Fig. 2) presents the degenerative characteristics of hypertrophic arthritis; but with the residual mechanical stress there is enlargement of the head of the femur with a broadening, flattening, or mushroom appearance. It is probably due to early injury and as the changes take place in the hip, the center of gravity is transmitted partially outside of the acetabulum. The osteophytic projections of the head are frequently underlaid with cystic changes.

4. Congenital anomalies, particularly old reduced dislocations of the hip, with age undergo hypertrophic changes that are extremely disabling.

One must realize from these common causes of painful hips that there are many cases that show a mixed etiology and many other systemic conditions that contribute to the pathologic picture.

TREATMENT

The treatment of these conditions is a matter of very intelligent election and should not be considered lightly. If recognized early, the symptoms are preferably controlled by conservative measures. To deal in detail with techniques of treatment, whether palliative, medical, or surgical, would be space-consuming and repetitious, as they are well publicized in the current medical literature. Suffice it therefore merely to mention them in order to provoke your investigation and interest.

Systemic disease and weakness should be corrected. Overweight is a common complication of painful hips. Reduction in weight will decrease strain on the weight-bearing mechanism and do much toward relieving the pain. Limitation of weight-bearing activity may be helpful. A walking stick or even crutches may be useful. Often, non-weight-bearing exercises keep up muscle tone without irritating the joint surfaces and the inflamed capsule. Hydrotherapy may be comforting and soothing.

When it comes to medication, as a surgeon I like to rely on my medical consultants, but we have found aspirin and the salicylates in large enough doses to be beneficial in certain instances. In the arthritides, gold, cortisone and ACTH should not be forgotten. In gouty and some of the arthritic manifestations, Butazolidin has proved an effective therapeutic agent. Hormonal therapy is recommended, when indicated. Intravenous procaine has been helpful. Compound F, when injected into the hip joint, has frequently given long periods of symptomatic relief. There are constantly being introduced from the vast realm of pharmaceutical research many new therapeutic agents that should offer relief to these sufferers.

Surgical treatment should only be considered after establishing the fact that intelligent medical and conservative measures have failed to give relief of pain and discomfort, or when the instability is of such a degree that the patient is not able to satisfy his desire to walk around in a relatively normal way. In many instances the discomfort syndrome may be very evident in a patient who has been so limited in locomotion that for some time he has been chair-bound. This occurs, for instance, with some old un-united fractures of the neck of the femur and severe polyarticular manifestations. In these cases surgical intervention offers little but relief of pain and an opportunity to make these poor people easier to take care of—or should we say, easier to live with.

Once we decide that surgical treatment may offer at least a partial solution to the problem, we must weigh the various procedures with respect to their appropriateness and with regard to what can be expected in the form of a satisfactory result. Even more important is the mortality risk involved in carrying

out any procedure, not only at the time of operation but also during the convalescent period.

Among the surgical procedures for relief of pain and disability of the hip in old people are the following:

a. *Fusion.* A stiff hip offers the surest method we know of for securing a painless joint; however, for the elderly individual it involves considerable risk. The surgical shock at the time of operation is considerable, and even if the hip is fixed internally by means of one or even two triflanged nails, there is a long period of convalescence because of atrophy, osteoporosis, or other bone metabolic deficiencies that require the patient to be tied down in a long plaster-of-paris spica cast for months. Such bed confinement lends itself to any number of complicating phenomena, of which you are well aware. Should the patient be so fortunate as to survive the ordeal, he ends up with a terrific handicap which is difficult to compensate for and which is likely to make him as unhappy with his lot as he was before operation. It is our opinion that to perform a fusion on an old person is to assume an absolutely defeatist attitude to the problem. Therefore we rarely recommend fusion in such cases.

b. *Neurectomy.* Sectioning the obturator and sciatic nerve branches to the hip capsule is a simple and commendable procedure and often gives a very marked relief from discomfort. However, in our experience, far too often some of these patients a year or two later return with more pain in the hip. Perhaps this may be due to increased instability and strain on other innervated tissues adjacent to the joint. Therefore, we carefully choose for neurectomy only those painful hips which have little evidence of loss of joint integrity and those having good stability.

c. *Revascularization.* The transplantation of muscle with enlivened blood supply into a window made in the neck of the femur has been recommended, but our success with this procedure has been disappointing. Perhaps this is because the patients we have tried to treat by this method arrived at our clinic too late in the course of their disease to make the operation worth while.

d. *Osteotomy.* This procedure is particularly commendable when internal fixation is used to immobilize the new relationship of the fragments. By means of this procedure, the patient can early become ambulatory. The more central weight-bearing thrust seems to relieve much discomfort. However, these patients usually have rather markedly diminished function and considerable difficulty in adjusting themselves to their limited range of motion. Furthermore, as time goes on, the pain may come back, with an actual increase in the pathologic condition of the joint surfaces. Nevertheless, we like osteotomy for certain non-unions in which other methods which might give relief are not indicated, particularly in some persons who are poor general risks but who could withstand a minimal surgical venture and have good potentialities for locomotion.

e. *Reconstruction.* There has been some success with the many rather extensive operative techniques devised for reconstruction of the hip joint by removing the head or reshaping it and the neck, and transplanting the great trochanter

FIG. 3. Non-unions are very disabling and, when there is wasting and shortening of the neck, the "Thomson light-bulb" type of prosthesis is particularly well suited for restoring joint integrity.

FIG. 4. The "Thomson light-bulb" prosthesis in place, giving a normal relationship between the new head and the shaft of the femur, which is conducive to weight-bearing.

downward on the shaft of the femur. We cannot often recommend them, as they involve not only extensive surgery but also long convalescent periods.

f. *Arthroplasties.* These procedures are finally confined almost to the cup type of arthroplasty which in younger people has proved most commendable; however, in older persons with extensive hypertrophic changes there is a tendency for the hypertrophic process to progress about the acetabulum and freeze the cup, thereby limiting the efficiency of this joint. The struggle to obtain function is often discouraging to one who has to battle with such a complication. I can speak from personal experience most feelingly and without prejudice, as I have had to combat this complication in my own case; but

TABLE 1

	No. of patients	Avg. age (yrs.)
A. Non-unions, including 3 with previous osteotomies	21	68
B. Fresh fractures, including 3 hemiplegias, 1 with severe osteoporosis and 1 bilateral case with prosthesis on other side for non-union	42	75
C. Osteoarthritis (including Legg-Perthes)	20	55
D. Aseptic necrosis	11	60
E. X-ray necrosis	2	74
F. Congenital dislocation of hip	4	30
G. Slipped capital femoral epiphysis	1	16
H. Septic hip	1	23
Total number of cases with Thomson-Lincoln Orthopedic Clinic type of prosthesis	*102*	
Groups according to age:		
90 and over (2 being 94)	5	
From 80 to 89	13	
From 70 to 79	31	
From 60 to 69	27	
From 50 to 59	9	
From 40 to 49	11	
Under 40	6	

we are still enthusiastic about cup arthroplasties in the younger and middle aged groups who need them.

g. *Hip prostheses.* To develop the historical data regarding the evolution of the present trend of popularity for the use of hip prostheses in the treatment of painful and disabling pathologic conditions of the hip would require too much space and would perhaps be confusing, and therefore irrelevant. There have been devised some 15 or 20 types of prostheses for the hip. The required technique of applying certain of these is often very mutilative to soft and bony tissues; others are more simple to insert into the femur; but all have virtues which their creators are enthusiastic about.

Our experience has led us to the conclusion that the best type of prosthesis for the head of the femur in old people is one which can be applied with the

least disturbance of the tissues—the least destructive surgery—and which restores as nearly as possible the normal weight-bearing relationship and functional activity of the joint.

In the beginning of our ventures into this field for the solution of this problem, we were quite enthusiastic over the Judet type of prosthesis and still recognize the adequacy of its principle in that it restores hip-joint integrity when one is dealing with a long femoral neck. However, we were impressed with its shortcomings, particularly when the neck was short, as is the case in old non-unions and in extensive degenerative changes about the hip (Fig. 3). These observations led to the development of the "light bulb" type of prosthesis. This procedure makes use of any strong cortical bone which may be left in the neck and fills the soft cancellous space with a solid, dependable, foreign-body mass which is transfixed into the heavy cortical bone of the lateral femoral shaft by means of a triflanged nail positioned as nearly as possible in the normal angle of the original femoral head and neck (Fig. 4).

Without going into the technique of operation, which has been published in the *Journal of Bone and Joint Surgery* for January 1952, suffice it to say that, by the use of the posterolateral approach to the hip joint, removal of the capsule, deepening of the acetabulum when needed, and properly seating the "light bulb" prosthesis, we have been able to achieve a measure of successful results not otherwise obtainable.

This should not be considered a panacea for the painful hip but it should be given due consideration if surgical intervention is indicated. Its proper execution takes but a relatively short period of time (25 to 60 minutes), involves minimal destruction of tissue, is tolerated well in properly selected cases, and usually gives relative relief of symptoms and improves the range of motion. One must not expect the impossible. An old hip deformity with long disability in an old person cannot be restored to full, normal function, but the degree of well-being and the increased comfortable activity are worth the effort. These patients can be up within a few days to a few weeks, out of the hospital, and going around as soon as they build up sufficient confidence.

Table 1 gives pertinent data regarding 102 consecutive patients treated by the "Thomson light bulb" prosthesis, giving diagnoses, and ages. No patient has died as the result of the surgery, but rather at some time later, of disease remote from the hip condition.

SURGICAL AND PATHOLOGIC PROBLEMS OF THE THYROID IN GERIATRICS*

HARWELL DAVIS, JR., M.D. AND J. E. KEARNS, M.D.

From the Departments of Pathology and Surgery, the Evanston Hospital Association, Evanston, and Northwestern University Medical School, Chicago, Illinois

The general principles of surgical therapy and gross and microscopic pathology apply to persons over 50 years of age, as well as to young adults. Changes occur relatively constantly in the structure of the thyroid with advancing age. These may be confusing to the pathologist and surgeon. We shall examine the changes with age, and discuss their confusing aspects. Clinical problems will be considered with reference to these changes in morphology.

The normal adult thyroid gland has a smooth external surface and a transparent capsule. It is cut easily, and has relatively regular acini. The connective tissue is delicate, scant, and evenly distributed. Alterations are roughly proportional to the age of the patient, and vary with the physiologic stress of preceding years (such as infection, pregnancy, and menstruation).

The thyroid gland of an older person becomes progressively more bosselated; its capsule thickens and becomes opaque. It is cut with more resistance (balsa wood). There is an increase in connective tissue, first evident about the smaller arteries and veins; from these it radiates to meet other thickened septa (Fig. 1). Eventually these septa enclose either partially or completely a portion of the gland. This process is usually incomplete. Portions of the involved areas may show only compressed thyroid acini, with slight increase in connective tissue.

The bosselations or nodules of age thus differ from the true adenomata more often seen in younger people. The bosselations are a mechanical result of the increased connective tissue from its point of origin, the blood vessels. These adenomatoid masses seldom attain a size comparable to true adenomas, and usually do not cause mechanical difficulties unless they are accompanied by secondary factors. The segment thus enclosed undergoes various retrogressive changes. It shows either exceedingly large follicles lined by a flat epithelium, or small follicles without colloid. Areas of papillary hyperplasia may also occur (Fig. 2). Changes in the staining properties of the colloid have been interpreted as characteristic of aging or of some malfunction of the gland (1). This is not true, since these changes depend upon fixation, pH of the stain, and other uncontrollable factors in the preparation of the tissue for microscopic study.

The progressive fibrosis may segregate and compress acini. Their epithelium disappears, leaving spaces resembling veins or lymphatics. Where recognizable acini remain, the area may be interpreted as a carcinoma, if there is not enough material for study (Fig. 3). The compression may cause changes in the epithelium

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of the acini, producing masses of cells resembling those described as Hürthle cells (Fig. 4A). It is our opinion that Hürthle cells, no matter where found, represent only a retrogressive change in thyroid epithelium.

There is infiltration with lymphocytes, with the formation of lymphoid follicles (Fig. 4, A and B). This change is seen more often in females. It results from the

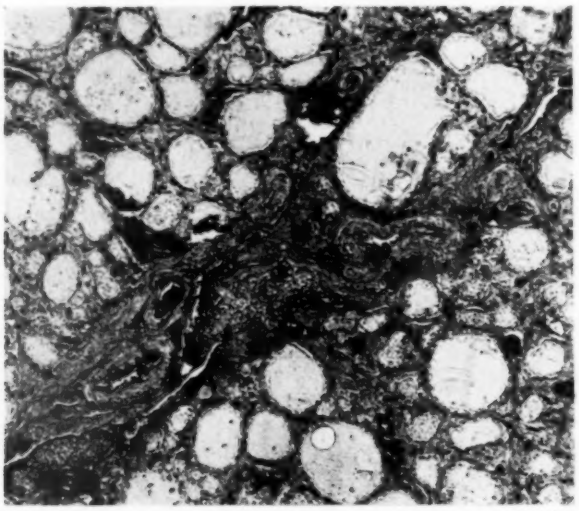

FIG. 1. Early increase of connective tissue about blood vessels.

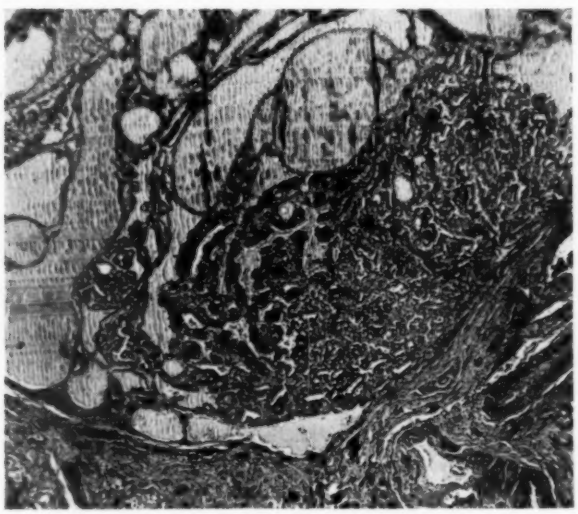

FIG. 2. Portion of "pseudo-adenoma", showing fibrous septa, papillomatous hyperplasia and large, irregular follicles.

more frequent episodes of physiologic stress placed upon their thyroid glands. It is similar to the lymphoid infiltration of Graves' disease, and may mimic the various forms of chronic thyroiditis, such as Hashimoto's or Riedel's struma.

Not only do the changes accompanying old age serve to confuse the recognition of cancer, but the cancer itself is different. In a group of 31 patients with

cancer of the thyroid gland, 5 had histologically bizarre tumors, such as a lymphosarcoma, spindle-cell and giant-cell carcinoma (Fig. 5, A and B). The remaining 26 had the more common papillary or alveolar type of adenocarcinoma. In our patients this latter type of cancer occurs in the third or fourth decade. Patients over 50 years of age with this type of tumor have survived from ten to forty

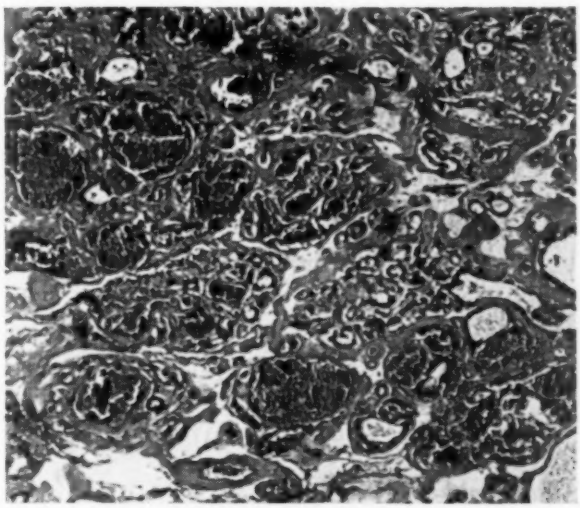

FIG. 3. Area simulating blood-vessel invasion.

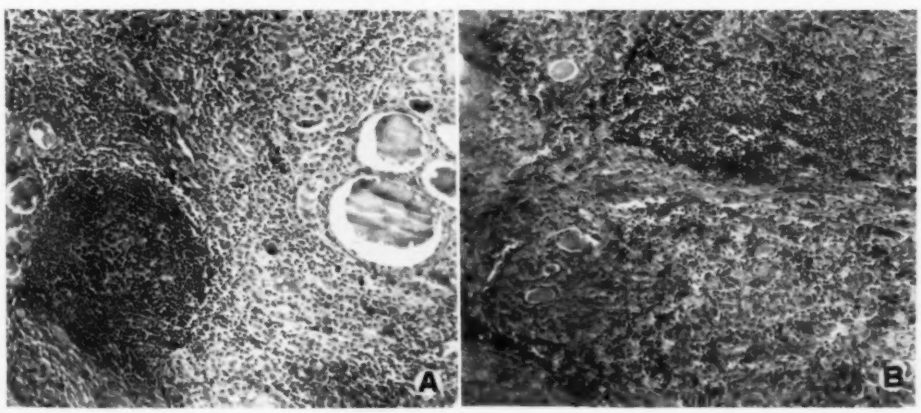

FIG. 4. A. Lymphoid follicle and Hürthle cells. Note also the variability of structure of the remaining thyroid acini.

B. Infiltration with lymphocytes, fibrosis and retrogressive change of follicles.

years after diagnosis. With 1 exception, all patients with papillary tumors were under 40 years of age when the tumor was found. Therefore, these papillary and alveolar lesions are not primarily of geriatric importance, but are of interest only because the patient has had a long survival. At this age radical procedures are contraindicated for these lesions. We suggest their removal in stages, in order to relieve pressure on adjacent structures.

The patients who had "peculiar" tumors are dead. The disease was demonstrated in all of them after the age of 60. These cancers diffusely involved the gland. In this respect they differed from the papillary, alveolar type with its relatively limited involvement. None of the patients past 60 had metastases distant from the neck, except 1 who had a lymphosarcoma which was apparently primary in the thyroid. All showed extensive local invasion. Death was due either to hemorrhage at the operative site, hemorrhage elsewhere, or respiratory obstruction and pneumonia.

In the diagnosis of tumors within the thyroid gland, radioactive iodine, I^{131}, is of no value. The uptake by functioning tissue surrounding the tumors is such that no differential counting for diagnosis is practicable. Neither is I^{131} of value in the treatment of these bizarre tumors, because they do not absorb it. The penetration of beta particles from I^{131} which may be taken up by adjacent normal thyroid tissue, is so shallow that it has no effect on the tumor. This in no way

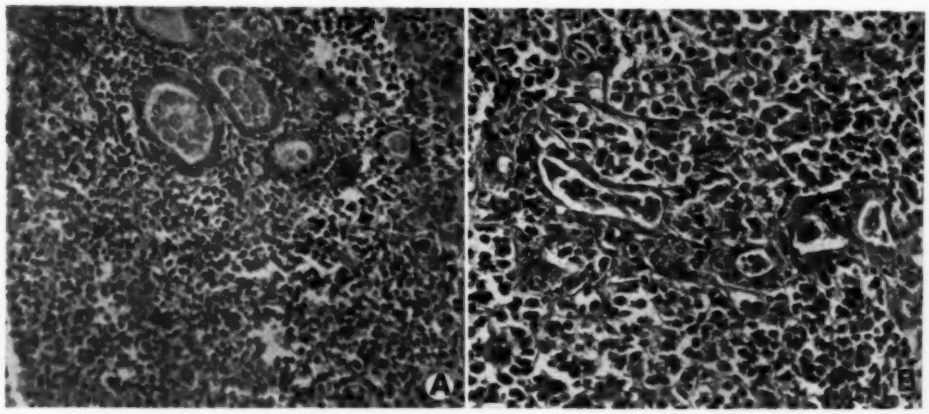

FIG. 5. A. Lymphosarcoma in the thyroid gland.
B. Peculiar carcinoma of the thyroid.

discredits the use of radioactive iodine in the diagnosis and treatment of hyperthyroidism. Roentgen radiation has been of no value, except in cases of lymphoma.

"Quick" section in the operating room is of questionable value. This is because of the similarity of tissue changes between aging and disease processes. The practice of "nipping-off" a bit of available tissue and submitting it for study should be condemned. We have emphasized that the gross examination is as important as any other in the diagnosis of cancer of thyroid gland. Without satisfactory biopsy, this is impossible. An adequate biopsy specimen should consist of a whole lobe or a major part of it (2).

Before operating upon these patients, they must be carefully examined with respect to the functions of the brain, heart, liver and kidneys, as well as the state of the blood. The failure of any one of these functions may be sufficient to cause death during an otherwise mechanically perfect operation. Proper fluid and minimal balance preoperatively and postoperatively is very important; homeopathic treatment is better than drowning the patient.

A well trained anesthetist is of utmost importance. He must supervise the use of fluids, and maintain an adequate airway by intubation. The use of a local anesthetic combined with general agents has been successful.

Tracheotomy (temporary or permanent), performed at the conclusion of the operation, is a routine procedure. It provides an adequate airway and allows aspiration of fluid if the patient cannot cough. We wish to denounce the routine postoperative use of the sitting position. These patients usually have less trouble if they lie flat or with a slight elevation of the foot of the bed. We prefer to use a tent rather than any other method of administering oxygen, because of the air-conditioning effect. Antibiotics intelligently used have been of assistance. A tracheotomy tube must be in place before giving x-ray therapy or heavy doses of I^{131}. Tracheotomy is emphasized, because 3 of our 5 deaths in this group were due to an inadequate airway.

SUMMARY

1. Aging produces a picture in the thyroid gland which is easily confused with adenomata, cancer, "Hürthle-cell tumors," and nonspecific forms of thyroiditis.

2. Cancer of the thyroid in the aged is reviewed, emphasizing its bizarre type and contrasting it with the papillary, alveolar lesions of younger persons.

3. Radioactive iodine has proved satisfactory in the diagnosis and treatment of hyperthyroidism, but is of little or no value in the peculiar cancers of the aged.

4. Cooperation among internists, anesthetists, and surgeons, before and after operation, is required.

5. The necessity of an adequate airway, maintained by intubation and tracheotomy during and after operation, is emphasized.

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PELVIC SURGERY IN THE ELDERLY PSYCHIATRIC WOMAN*

ARMAND JEAN MAUZEY, M.D. AND GEORGE B. KAKNES, M.D.

From the University of Illinois College of Medicine, Chicago, and the Elgin State Hospital, Elgin, Illinois

Although most female patients admitted to a Psychiatric Hospital suffer from impaired mental health, serious organic disease may be also present. This organic disease is often located in the organs of reproduction. Although a disease of the organs of reproduction in any age group, whether the woman is mentally ill or not, may be of grave importance, in the psychiatric woman over 50 years of age it presents special and peculiar geriatric problems. It will be the purpose of this paper to draw attention to some of those problems and to discuss the surgical management of gynecological trends.

CLINICAL MATERIAL

The present study was based on an evaluation of the Gynecological Service at the Elgin State Hospital, Elgin, Illinois, from October 1, 1949 to May 1, 1952. This institution contains some 3,000 female patients, about two fifths of whom are over 50 years of age. During the period in question approximately 5,000 pelvic examinations were made by the Gynecological Resident and the Attending Gynecologist, which resulted in 317 operative procedures, of which 104 were on women over 50 years of age (Table 1).

These women ranged in age from 50 to 80 years. There were 57 in the 50–59 age group, 30 in the 60–69 age group, 15 in the 70–79 age group and 2 over the age of 80 years (Table 2).

The gynecological indications for surgery varied (Table 3). There were times when the patient had no complaint or expressed none, and yet pelvic examination would reveal a large pelvic tumor or a completely prolapsed uterus. Abnormal vaginal bleeding more often than not, was discovered by the ward attendants and became the reason for examination. The pathological condition found, followed the pattern of disease seen in most active gynecological services involving the older age groups. The fact that fibromyoma of the uterus was the major indication for surgery in 22 cases should warn us that not all fibroids regress after the menopause. Most of the fibromyomata were large, filling the pelvis, and most were free of bleeding. The high incidence of prolapsis uteri was to be expected in women over 50. The Papanicolaou smear was carried out routinely on all suspicious lesions of the cervix but with regard to contributing something distinctly valuable toward diagnosis, it had limited value in this series.

The mental illness of these patients could not be correlated with the organic diagnosis. It was found that 30 had a diagnosis of involutional melancholia,

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TABLE 1
Total Number of Operations

October 1, 1949 to May 1, 1952	317
Over age 50 (33 per cent)	104
Under age 50	213
Deaths	None

TABLE 2
Ages over 50

	No. of cases
50–59 yrs.	57
60–69 yrs.	30
70–79 yrs.	15
80–	2
Total	104

TABLE 3
Indications for Surgery

	No. of cases
Fibromyoma uteri	22
Prolapsus uteri	19
Postmenopausal bleeding	9
Recto-enterocele	5
Uterine polyps	5
Cystocele with incontinence	5
Meno-metrorrhagia	5
Chronic endocervicitis	4
Suspicious Pap. smear	3
Cysto-rectocele	3
Prolapsed vaginal vault	3
Adeno ca. of corpus	3
Ovarian tumor	3
Adeno ca. of cervix	1
Squamous-cell ca. of cervix	2
Prolapsed cervical stump	2
Gartner's duct cyst	2
Vesico-vaginal fistula	1
Recto-vaginal fistula	1
Kraurosis vulvae	1
Basal-cell ca. of vulva	1
Bartholin's gland	1
Adnexal disease	1
Intraligamentous cyst	1
Ventral hernia	1
Total	104

17 of dementia praecox and 15 of senile psychosis. The remaining patients suffered from a wide range of psychiatric conditions (Table 4).

SURGICAL TREATMENT

Operations. Two thirds of the surgery performed was by the vaginal route, as compared to the abdominal approach (Tables 5 and 6). This figure was

TABLE 4

Psychiatric Diagnosis

	No. of cases
Involutional melancholia	30
Dementia praecox	17
Senile psychosis	15
Psychoneurosis	11
Paranoia	11
Lues	5
Manic-depressive psychosis	4
Cerebro-arteriosclerosis	4
Epilepsy	3
Mental deficiency	2
Undiagnosed psychosis	2
Total	104

TABLE 5

Operations by Vaginal Route

	No. of cases
Vaginal hysterectomy with plastic surgery	22
Vaginal plastic alone	12
Dilatation and curettage	22
Bartholinectomy	1
Repair of recto-vaginal fistula	1
Repair of vesico-vaginal fistula	1
Vulvectomy	2
Radium insertion	3
La Forte operation	4
Biopsy of cervix	2
Total	70

influenced by the number of cases (twenty-two) requiring a dilatation and curettage. Vaginal hysterectomy with plastic surgery was used in 22 instances. It is our custom to include at least a perineorrhaphy in older women as a prophylaxis against subsequent prolapse. Most of the vaginal hysterectomies were accompanied not only by a perineorrhaphy but a Kelly plastic and cystocele repair as well. When a completely prolapsed uterus was present (the uterus

resting on the perineum), when advanced age and a medical complication had to be considered, and when marriage responsibilities had long since vanished, the La Forte procedure was adopted. It was used four times with moderate success.

The one case of repair of a vesico-vaginal fistula presented a special problem. An attempt at correction had been made a number of years before without success. The fistula was located high in the vaginal vault and had followed a total abdominal hysterectomy. The patient was paretic and was very unruly. Keeping her in bed during the postoperative period would have been difficult. Because of the paresis, a general rather than a spinal anesthetic was used. The operative technique was not difficult. It was decided to allow the patient up, with an indwelling Foley catheter attached to a bottle on the floor. Bladder irrigations by gravity were performed every three hours around the clock for five days; then every six hours, every eight hours and finally twice daily, until the patient was discharged at the end of two weeks. She had an uncomplicated recovery. Apparently the sitting position, by encouraging compression of the vaginal walls, and

TABLE 6

Operations by Abdominal Route

	No. of cases
Total abdom. hysterectomy with adnexal surgery	26
Supracervical hysterectomy with adnexal surgery	1
Excision of ovarian disease	3
Repair of incisional hernia	1
Abdom. suspension of prolapsed vag. vault	3
Total	34

the constant catheter drainage, made healing easier. The 5 cases of recto-enterocele were interesting. The incidence of this condition was high, leading us to wonder if we have been missing this diagnosis in private-practice patients. It is now our custom to think of a large rectocele as being complicated by an enterocele, until disproven at the operating table. It is not easy to distinguish between these conditions by simple rectovaginal examinations. The tendency toward constipation which these patients have, may predispose to enterocele and rectocele.

The abdominal surgical approach was used on 34 occasions (Table 6). There were 26 total abdominal hysterectomies, with adnexal surgery. Since these women were over 50 years of age it was deemed unnecessary to preserve ovarian function. One supracervical hysterectomy was performed. This was in a patient 66 years of age who had multiple calcified fibroids growing into the cervix and subcervical regions. Because of the technical difficulties, total hysterectomy was not attempted. Of the ovarian tumors removed, one proved to be a malignant arrhenoblastoma in a woman 81 years of age. The operation was carried out under local anesthesia. Less than ten such tumors have been reported in the

literature. The tendency to perform more total abdominal hysterectomies may invite a higher incidence of prolapsed vaginal vaults. Three such cases were repaired in this series by using the Falls technique of suturing the vaginal vault to strips of suprapubic rectus fascia within the abdomen.

In 7 instances endometriosis complicated the abdominal approach and invariably seemed to show a predilection for the left side of the pelvis. Again one may ask—can the constipation which is most always present in the psychiatric female, encourage a high incidence of endometriosis, particularly on the left side? The presence of endometriosis involving the left broad ligament and sigmoid and causing firm adhesions, made surgery difficult. On two occasions the sigmoid was perforated in separating these adhesions. Both cases responded without postoperative complications to three layers of cat-gut closure and the rectal insertion of a large colon tube to a point above the field of injury.

Preoperative care. Ideal preoperative care for elderly psychiatric women is not always possible. Although these patients were examined on admission by the Gynecological Resident, re-examined and evaluated by the Attending Gynecologist and admitted to the General Hospital unit several days in advance of their

TABLE 7

Preoperative Care

Laboratory—Blood count, urinalysis, NPN, fasting blood sugar. Blood typed and cross-matched; prothrombin time.
Medical consultation
Blood transfusion (if necessary)
Medication—Morphine sulfate, gr. ⅛ to ⅙, and atropine, gr. 1/150; or m. sulf., gr. ⅙, and scopolamine, gr. 1/150. Penicillin 300,000 u. Occas. balsam Peru vaginal pack before surgery if prolapse complete. Vit. B complex and feosol. Ascorbic acid and vit. K, pre- and postoperatively, if prothrombin time abnormal.

day for surgery, their mental behavior on occasion made preoperative care a problem. On the other hand, some of the women, who upon arrival on the gynecological ward were severely upset, quieted down and became model patients. With few exceptions, a definite, rigid preoperative routine was followed (Table 7). This involved a complete physical examination and a urine and blood work-up, including nonprotein nitrogen and fasting blood sugar.

Just as a psychiatric patient may have a gynecological disorder, she may also have a cardiac or kidney problem. Most of our elderly psychiatric women had medical complications of varying importance, involving blood pressure, heart, kidneys or the peripheral vascular system. Medical and general surgical consultations were sought freely. Blood transfusions before operation were occasionally necessary. These patients, surprisingly enough, showed fairly satisfactory blood pictures, *i.e.*, a red blood cell count of at least 3,750,000 and a hemoglobin of at least 11 grams. If the type of surgery seemed to warrant it, they received penicillin in daily doses of 300,000 units prior to, and after operation. Vitamin B Complex was used along with feosol. Ascorbic acid and vitamin K were given if the prothrombin time was unsatisfactory.

Anesthesia. Much thought was directed to the type of anesthesia selected (Table 8). Local anesthesia was used in 32 instances and the inhalation route in 72. In the 50–59 age group there were 47 general and 10 local anesthesias; in the 60–69 age group there were 19 general and 11 local anesthesias; and in the 70–79 age group there were 5 general and 10 local anesthesias. Two patients over the age of 80 were operated on; one had a general anesthetic and the other had a local. It will be noted in Table 8 that as the age advanced, the percentage of local anesthesia increased. Of the 15 cases operated on in the 70–79 age group, 10 were by local anesthesia. One per cent procaine was used, in an amount which averaged about 100 cc. per patient.

The value of local anesthesia in pelvic surgery probably has not been adequately explored, especially in regard to the elderly psychiatric female. These women, in spite of severe mental illness, react very well to local anesthesia. In our

TABLE 8
Anesthesia

Age group	General	Local
50–59	47	10
60–69	19	11
70–79	5	10
80–	1	1
Totals	72	32

TABLE 9
Postoperative Care

Blood transfusions—In two thirds of the cases
Intravenous fluids—1000–1500 cc. H_2O and 5% dextrose
Ambulation—Up on first day often, by second day almost always.
Medication—Ascorbic acid daily, 300 mg. polyvitamins. Morphine sulfate, gr. $\frac{1}{8}$ to $\frac{1}{6}$ p.r.n. Postop. distention necessitating Wangensteen, rare.

series of major operations, at least one of each type was performed under local, including vaginal and abdominal hysterectomy, excision of ovarian cyst, repair of prolapsed vaginal vault and the La Forte and vulvectomy operations. One hour prior to surgery morphine sulfate, gr. $\frac{1}{8}$ to $\frac{1}{6}$, was given in combination with scopolamine, gr. $\frac{1}{150}$; half an hour later the scopolamine was repeated. When general anesthesia was selected, morphine sulfate, gr. $\frac{1}{8}$ to $\frac{1}{6}$, was administered with atropine sulfate, gr. $\frac{1}{150}$, one hour before surgery. The initial induction of general anesthesia was accomplished under intravenous pentothal, following which inhalation ether and nitrous oxide were used.

Postoperative care. During surgery and in the immediate postoperative period, most patients received at least 500 cc. of blood and up to 1,000 cc. of sterile water and dextrose (Table 9). There were no blood transfusion reactions. Morphine, in small amounts, was administered as indicated. Ascorbic acid was

given daily in a dose of 300 mg. With few exceptions these patients were up and around by the second postoperative day and many were up on the first day. Postoperative distention was seldom present. During the past year it was not once necessary to use the Wangensteen suction technique.

Complications (Table 10). There were no operative deaths. On 3 occasions, small hematomas appeared in the abdominal incision. In 2 of these cases, local anesthesia had been used. Postoperative vaginal bleeding occurred twice, once

TABLE 10

Complications

	No. of cases
Hematoma in abdominal incision	3
Postoperative vaginal hemorrhage	2
Thrombophlebitis	1
Cardiac decompensation	2
Pelvic cellulitis	1
General anesthetic difficulties	4
Surgical difficulties	1
Poor surgical results	2
Total	16

TABLE 11

Malignancy (9 cases)

Age of patient	Diagnosis and treatment
53	Adenocarcinoma of corpus—Radium and x-ray
81	Arrhenoblastoma ovary—Excision and x-ray
53	Squamous carcinoma of cervix, Group III—Radium. Died eight months later from metastasis
65	Adenocarcinoma of corpus—Radium and x-ray
65	Adenocarcinoma of corpus—Radical total abd. hysterectomy
69	Basal-cell carcinoma of vulva (early)—Vulvectomy
78	Epidermoid carcinoma of cervical polyp—Excision and cautery. Died two months later with cardiac decompensation
54	Pap. serous-cyst adenocarcinoma of ovary—Radical total abd. hysterectomy and x-ray
51	Adenocarcinoma of cervix, Group III—Biopsy

after total abdominal hysterectomy and once after vaginal hysterectomy; both cases responded to vaginal packing. There was 1 case of thrombophlebitis of the right femoral vein. The patient recovered with the aid of bed rest and antibiotics. In 2 patients mild cardiac decompensation developed. There was 1 case of full-blown pelvic cellulitis with high temperature and chills, which responded to sulfa drugs and penicillin.

There were 4 instances (2 during surgery and 2 at the end of surgery) in which patients had anesthetic difficulties or suffered from operative shock, character-

ized by a drop in blood pressure and respiration, with a thready pulse. In none had the blood loss been excessive. All responded rapidly to intravenous sterile water and glucose. It was necessary once to complete a vaginal hysterectomy by the abdominal route. The postoperative results in 2 patients were not satisfactory. In each, a La Forte operation had been performed under local anesthesia. In one, the lower half of the vaginal wall approximation separated, but to date the prolapsus uteri has not recurred. In the other, urinary incontinence developed but was subsequently corrected by a Kelly plastic operation. There were no other postoperative urinary complications. Postoperative catherization was rarely used. Many of these patients seemed to be mentally improved following surgery. Occasionally one seemed to be worse.

Malignancy. There were 9 cases of malignancy in the series (Table 11). Three cases were adenocarcinomas of the body of the uterus, 2 of which were treated by radium and x-ray and 1 by radical abdominal hysterectomy alone. One patient, 81 years of age, had a malignant arrhenoblastoma of the right ovary. The cervix was involved in 3 instances. In 2 of the 3, advanced Group III squamous-cell carcinomas were present; 1 of these patients expired from metastases eight months following radium therapy. The third case was an epidermoid carcinoma of a cervical polyp; two months after excision and cautery, the patient died from cardiac decompensation. In addition, there was 1 small basal-cell carcinoma of the vulva treated by radical vulvectomy alone, and 1 early papillary serous-cyst adenocarcinoma of the ovary, managed by radical abdominal hysterectomy and x-ray therapy.

SUMMARY AND CONCLUSIONS

Several observations need to be emphasized as a result of this study.

1. Elderly psychiatric women will survive major as well as minor pelvic surgery with good postoperative results.
2. No correlation was found between the mental illness and the gynecological lesion, although a number of patients seemed to be improved following surgery.
3. The use of local anesthesia can be adapted to these patients and has definite advantages as the age scale rises.
4. Total abdominal hysterectomy in this series proved to be a sound procedure.
5. Early ambulation, adopted more or less from necessity because most of these patients would have succeeded in getti ng up anyway, apparently produced no harmful results and in many ways was believed to be beneficial.
6. The high incidence of malignancy in the elderly psychiatric woman needs to be further evaluated.
7. It is imperative that mental hospitals be so equipped that a Gynecological Service is possible, supervised by at least a full-time Resident and an Attending Gynecologist. Only in this way can these unfortunate patients have their pelvic disorders adequately treated.

EFFECTS OF METRAZOL AND NICOTINAMIDE ON PSYCHIC AND MENTAL DISORDERS IN THE GERIATRIC PATIENT:

A PRELIMINARY REPORT*

HERMAN SEIDEL†, M.D., ABRAHAM A. SILVER, M.D.
AND HENRY NAGEL, M.D.

Baltimore, Maryland

The following is a report on a limited study of the therapeutic value of metrazol and nicotinamide in a selected group of aged people suffering from a variety of cerebral deficiencies. This study was carried out at the Levindale Hebrew Home & Infirmary in the City of Baltimore.

The plan of our study was as follows. At the Home we studied 17 patients, of whom 5 were given metrazol; 5, nicotinamide; and 7, both nicotinamide and metrazol. One of us (H.S.) studied 3 cases on metrazol while another of us (A.S.) studied 3 cases on nicotinamide outside of the institution, making a total of 23— 8 on metrazol, 8 on nicotinamide, and 7 on combined therapy.

The dosage was moderate. We administered from 6 to 9 grains of metrazol daily, and an average of 400 mg. of nicotinamide daily. Our patients were selected with the view of eliminating clinical conditions known to be complicated by cerebral disturbances, such as uncontrolled diabetes, pernicious anemia, malignant hypertension, or hepatic disease. We limited our selections to patients who displayed the symptomatology of cerebral disturbances without any evident clinical pathologic condition to explain their symptoms.

The value of nicotinamide in senile cerebral disturbances has been studied recently and its effects in sclerosis were reported on by Fleetwood from Ireland (1) before the Second International Gerontological Congress in St. Louis. Metrazol has been studied by Chesrow (2) on the general medical wards of the Cook County Institutions, Oak Forest, Illinois. Both investigators report favorably on the effects of the respective drugs they have studied. Metrazol therapy in Chesrow's series was associated with improvement in 75 per cent of the cases. Fleetwood in his report likewise stated that he found improvement in approximately 70 per cent of his cases. He is apparently favorably impressed and is continuing his studies on a much larger scale. However, there is one phase of his study that would raise the question of whether nicotinamide could be given full credit for the improvement noted. He reported the use of small doses of potassium iodide and aromatic spirits of ammonia throughout the treatment. Potassium iodide, at least, has a well-earned reputation for producing beneficial

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† Address: 2404 Eutaw Place, Baltimore 17, Maryland

effects in some cases of arteriosclerosis and hypertension, if given over a considerable length of time. In our studies we have practically eliminated the use of all drugs that may have effects similar to nicotinamide and metrazol on cerebral conditions. Thus, the benefits noted following treatment with nicotinamide and metrazol may be credited solely to these drugs.

Metrazol and nicotinic acid have attracted the attention of clinicians and researchers as suitable drugs to be employed in the treatment of cerebral and mental disturbances. They have attracted this attention by virtue of their pharmacologic characteristics and the therapeutic effects they have displayed in a number of conditions.

Metrazol when given in large doses by mouth or in moderate doses parenterally will produce convulsive seizures similar to the grand mal of epilepsy. Because of this effect, the drug has been for some time employed in the treatment of mental disturbances, including schizophrenia, when shock treatment is indicated. It has also established a reputation as a respiratory stimulant. Metrazol apparently has widespread effects on the circulatory, respiratory, and mental functions. It has been found to affect the patient's mood, tending to produce a state of euphoria and encouraging a cheerful mental attitude. Its pharmacologic mechanism is not clearly understood. When it is given to the extent that convulsive seizures result, it is thought that it is producing a hypertensive effect and thus improving cerebral vascularity. On this basis, it is argued that it may produce a favorable vascular effect without a definite convulsive seizure, *i.e.*, it may produce short-lived hypertensive effects, and thus exert an influence on the vascularity of the cellular structure of the cerebral tissue. Again, it is probable that the cerebral improvement following metrazol therapy is an indirect effect brought about by the respiratory stimulation, which improves the oxygenation of the cerebral tissues.

Nicotinamide has gained its reputation mainly by its beneficial effects in pellagra, in which it particularly shows favorable therapeutic influence on the associated cerebral conditions. It, too, attracted attention and caused clinicians to believe that nicotinic acid has a particular influence on cerebral conditions because of the general flushing of the face, neck, and scalp following its administration. Deductions have been made from this observation that in a similar fashion nicotinic acid causes a flushing of the brain tissue, and in that way enhances the vascularity of the brain, thus improving the pathologic condition that may exist. To date, it is not at all clear as to the manner in which nicotinic acid exerts its favorable influence. In a recent article (3) Scheinberg refutes the assumption that nicotinic acid increases cerebral vascularity, by testing the arterio-venous differential following the intake of nicotinic acid. Scheinberg is not convinced that there is an increased flow of arterial blood in the brain tissue. He asserts that the flushing of the face and neck is no evidence that similar flushing takes place internally. He claims, on the contrary, that any observed increase in venous flow may have been contamination from the increased vascularity of the superficial circulation.

SUMMARY

We have to date studied 23 cases under metrazol and nicotinamide therapy for a period of approximately ten months. These subjects presented the following general symptomatology:

Poor memory
Confusion
Neurasthenic or psychoneurotic complaints
Quarrelsome and negativistic attitudes
Paranoid ideas
Depressive states
Hyperagitation
Paresthesias

The ages of the patients ranged from 62 to 89 years. The majority of them were considerably over 70 years, the oldest being 89 years. The 6 patients outside the institution were within the same age group. Of the 23 subjects studied, 8 showed no improvement and 15 showed moderate to good results.

We were impressed with the fact that improvement was much more noticeable in those persons exhibiting symptoms of impaired behaviorism; the failures occurred mostly in the group with symptoms pertaining to intellectual impairment. Although we have no definite explanation of this selective response, we may postulate that it depends on the degree of organic changes in the brain tissue. Because, as a rule, intellect and memory are first to suffer, whereas personality and behavior changes appear later, it may be assumed that the intellectual phenomena depend on more definite organic changes which are probably irreversible. The psychoneurotic changes, on the other hand, may depend more on the nutritional state of the brain tissue and the degree of its oxygenation. The only case in our series in which treatment was 100 per cent successful was that of a 77-year-old woman who suffered from paranoid ideas, depression and bouts of hyperagitation and who was twice treated with electric shock therapy unsuccessfully. This woman, after two months of nicotinamide plus metrazol behaved normally and resumed routine activities.

The subject needs much more study before our observations can be either affirmed or denied. To date we can report only that in our series of 23 patients with cerebral disorders there was clinical evidence of improvement in 65 per cent of the cases following treatment with metrazol and nicotinamide; certainly this is a step forward in the halting of degenerative processes. We shall endeavor to continue the study in greater detail with a larger number of patients.

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PSYCHIATRIC AND MEDICAL ASPECTS OF A COUNTY HOME SURVEY IN IOWA*

RAPHAEL GINZBERG, M.D.† AND WILLARD C. BRINEGAR, M.D.‡

From the Gerontological Unit, Mental Health Institute, Cherokee, Iowa

County homes in Iowa are former "poor houses," "poor farms" or "county farms." They are under the jurisdiction of county authorities. The official in charge is called, as in good old times, the "Overseer of the Poor."

Residents of the county homes consist of adults of all age groups. Many of them are psychotic. Alcoholics form another large group. Other residents are mentally normal individuals. Some of the mentally normal have been transferred as chronic and hopeless cases from general hospitals. Another group consists of needy persons, predominantly elderly, who continued to be unemployed for some time and constituted a problem for the community: this group is called "the poor." A few, particularly alcoholics, are taken directly to the county homes from jail. Some of the psychotics are transferred from the Mental Health Institutes (State Hospitals).

This report is based on a survey which was conducted by the Gerontological Unit of the Cherokee Mental Health Institute. The method applied in this survey was that of questionnaires and interviews. Questions concerning health and mental condition were part of a survey of "Attitudes, Background, and Health of Elderly People in County Homes with a View to their Personal and Social Adjustment." The questionnaire consisted of 315 questions, 88 of them concerning physical and mental health. When good contact with the individual was possible, the questioning and interview was more detailed. With the psychotic residents, the interviewers had to rely on less formal talks. In cases in which no contact was possible, information was obtained from the personnel of the home. No further details of the technique used will be described here.

The majority of the residents of the four county homes included in this survey were elderly persons. Among 229 residents, 126, or 55 per cent, passed their 65th birthday.

The elderly were grouped according to their mental status in the following classifications:

1. Normal (without psychosis)
2. Mildly mentally ill (with moderate mental symptoms, or, although normal at the time of interview, had had mental hospital records in the past)
3. Psychotic (with obvious symptoms of mental diseases)
4. Unclassified (those who could not be placed in any of the categories because of lack of information regarding their mental status. This group

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† Former Director of the Gerontological Unit (Cherokee). Now Senior Physician in charge of Geriatric Program, Veterans Administration Hospital, Tomah, Wisconsin.

‡ Superintendent, Mental Health Institute, Cherokee, Iowa.

included a deaf person, a mute, and persons with whom an understanding was not possible because of language barriers.)

The normal (36.2 per cent) and the psychotic (39.2 per cent) form almost equally large groups, with the mildly mentally ill constituting 17.7 per cent and the unclassified, 3.9 per cent.

The youngest subject was 65 years old, the oldest 96. The mean age was 75.2 years.

There were 87 men and 39 women investigated, the male-female ratio being 9:4 for all subjects, 6:1 for normal, and almost 1:1 for psychotic subjects.

About 62 per cent of the normal and 49 per cent of the psychotic subjects had never been married. At the time of the survey, 94.4 per cent of all the subjects were either single, separated, divorced, or widowed.

Only 28.6 per cent stated that they had lived in cities most of their lives. We were dealing in this inquiry with a predominantly rural or rural-farm population.

The present health status was judged to be very poor or poor in about 20 per cent, fair in about 45 per cent, and good in about one third (32.5 per cent) of the subjects.

More than 50 per cent of the normal and mild mental, and more than 90 per cent of the psychotic persons, were limited in their movements. Almost 16 per cent were bedfast. Only 31 per cent of the elderly residents were permitted to move freely, visit their friends, or go downtown. The reasons given for limitations of movement were almost equally divided between physical condition (36 per cent) and mental condition (42 per cent).

The survey covered almost every aspect of mental and physical health. The findings have been summarized in more than 20 tables. Since this report will have to be brief, only some of the results will be discussed, with the main purpose to demonstrate the value of the method employed.

Appetite was stated to be good or fair in 83 (82.5) per cent of subjects; it was good in almost 70 (69.7) per cent, and fair in about 13 (12.8) per cent.

Constipation was far less of a problem among the subjects of this sampling than would be anticipated. Its incidence was higher among normal and practically normal, and lower among psychotic subjects; 17.4 per cent considered themselves as being constipated, and only 10.3 per cent used laxatives or enemas.

Frequency of micturition was a greater problem than constipation; 31.4 per cent of normal and mild mental subjects, and 19.8 per cent of the whole sampling, complained of frequency of urination.

Headache (in 27.1 per cent) and dizziness (in 32.8 per cent) were rather frequent among the nonpsychotic and mild mental subjects. However, insomnia, which is considered a common symptom in advanced life, was noted in only 15 out of 70 cases, or 21.4 per cent.

There was a comparatively large number of the elderly who displayed symptoms of organic nervous diseases; 25 (almost 20 per cent) were classified in this group. Among them were 7 patients with hemiplegia, 3 with paraplegia and 5 with epilepsy. Some of the mentally normal hemiplegics were bedfast for from seven to eight years.

Most impressive were the psychiatric findings. Among the normal subjects the only deviations found were mild memory defects, in 23.4 per cent. In the mildly mentally ill the percentage of memory defects was substantially greater. There was also a high percentage of subjects in whom no decision could be made as to different psychotic manifestations.

Of course, the frequency of psychotic symptoms was highest among psychotic individuals. Pathologic symptoms were found among them in the following order of frequency:

Delusions	65 per cent
Confusion	57 per cent
Memory impairment	57 per cent
Orientation impairment	33 per cent
Hallucinations	29 per cent

Psychiatric diagnoses were available only for those residents who had once been patients of the Cherokee Mental Health Institute (formerly the State Hospital). Of the persons in this study, 43 were found to have records there; 4 of them were alcoholics with a diagnosis "without psychosis" and they were classified as normal; the other 39 were distributed among the psychotic and mild mental groups. Among the psychotic elderly, 46 per cent had no psychiatric diagnoses; these people were never seen by a psychiatrist, nor were they patients in a mental hospital.

Almost two thirds of the elderly psychotics (64.9 per cent) had been suffering from mental diseases since their younger years. These were psychotic individuals who became old while being institutionalized. In only 35 per cent of the elderly psychotics did psychoses develop in the later years.

Of interest is the length of institutionalization of the elderly psychotic residents. Some residents had spent more than half a century in county homes and state hospitals. The longest period of institutionalization found in this survey was 55 years; 8 of the elderly psychotic subjects were institutionalized for more than 40 years.

The mean stay in institutions was 30 years for the psychotic elderly in whom psychoses developed in younger life; the stay was longer for those diagnosed "manic-depressive" (33 years) and slightly lower for those diagnosed "schizophrenia" (26 years). The mean stay in county homes of the undiagnosed psychotic subjects (those who were never seen by a psychiatrist), was 18.4 years, the longest being 33 years. Of course, the mean stay of elderly psychotics in whom the disease developed in advanced life, was considerably shorter. Significant is the fact that only 1 out of 26 psychotic residents of this group was seen or examined in a mental hospital. The rest (96 per cent) were taken directly to the county homes.

COMMENT

The newly-created Gerontological Unit of the Cherokee Mental Health Institute felt that its primary task should be to make an inventory and to gather material on the elderly in the northwestern part of Iowa, the region serviced by the Mental Health Institute. The Unit began with an exploration of those

elderly persons commonly thought to be literally at the "end of the road"—the residents of county homes. It was decided to begin the study by obtaining information through and from the elderly persons themselves. The Unit is aware of the shortcomings of the method, and considers this as a pilot study. It may be said, however, that the interviews with 130 elderly persons supplied the Unit with a wealth of information.

The system the Unit found in operation in the county homes is based primarily on the principles of custodial care. This system was created and has been directed by laymen. Members of the medical profession are called in, but this for limited purposes only, mainly in the treatment of acute physical illnesses.

There is an awareness of the need for trained nursing personnel; nurses are desired and are sometimes employed, but sufficient funds are often not available. In addition, the unsatisfactory medical set-up discourages nurses from accepting positions, or from staying any length of time when they do accept them.

Those in charge of the homes are either unaware of, or are unprepared to accept, the idea that custodial care is not the only approach to the numerous healthy and sick aged persons in their care. They do not seem to realize that at least some of the residents whom they consider to be helpless and hopeless can be rehabilitated. Among the crippled and invalidized normal elderly residents none has had the benefit of rehabilitative services, and among the psychotic residents practically none has had the benefit of modern psychiatric treatment.

The psychotic subjects present a gloomy segment of the county-home population. Contemporary ideas of treatment and management, such as occupational-, and psycho-therapy, or an approach based on psychological understanding, have not found their way into, or been incorporated in, the principle guiding those in charge of psychotic patients. Other methods of treatment, which require greater professional knowledge or technical equipment, such as electro-coma treatment or psychosurgery, are not even considered in connection with these psychotics.

In spite of many unfavorable factors, the team found, in the county homes, a group of people who succeeded in reaching advanced life, some having passed their 90th and even their 95th birthdays. A considerable proportion of those studied (about one third) were found to be in good physical health. Seen from a purely medical standpoint, this group of the elderly provided a valuable source of information regarding many aspects of old age.

This survey demonstrates the value of pilot studies of this kind. It should be followed by a thorough investigation of the physical, mental, and psychological condition of the elderly persons studied. It demonstrates also that screening of the elderly residents of such institutions is called for. Although medicine and psychiatry are still relatively helpless in the treatment and management of many geriatric cases, much more can be achieved in the county homes than at present. Steps in this direction appear to be warranted from the standpoint both of the individuals involved, and the community in general.

Current Geriatric Literature

PERSONALITY CHARACTERISTICS OF THE INSTITUTIONALIZED AGED.
Helen H. Davidson, and Lorraine Kruglov.
J. Consulting Psychol. **16:** 5–12, 1952.

It was the purpose to determine by the Rorschach method the major personality characteristics and adjustment level of a group of institutionalized old people. Twenty-four men and 22 women, between the ages of 61 and 91 were examined. A great deal of variation in their experiences was found regarding their socioeconomic background and education.

Outstanding personality characteristics were:

1) Low productivity and little drive.
2) Faulty perception of reality and peculiar thought processes.
3) Narrowing of range of interests.
4) Lack of capacity for independent and creative thinking.
5) Inability to delay expressions of impulses.
6) Decreased emotional responsiveness.
7) Inadequate feelings toward self and generalized feelings of insecurity.
8) Less adequate adjustment, women showing better adjustment than men.

Interindividual variation could not be accounted for in terms of age, marital or parental status, and educational or occupational level.

Comparisons between the institutionalized and other old people living at their home indicated that the institutionalized group seemed to assume the characteristics of personality of the aged earlier than the non-institutionalized group.

Laverty concluded that mental and physical deterioration may be retarded by encouraging normal community living for older people; this conclusion was reached after comparing adjustment of aged people living in an institution with those living at home and calling upon the institution for medical and social aid.

ECONOMIC SECURITY FOR OLD AGE.
Editorial.
Canad. J. Publ. Health **43:** 90–92, 1952.

The new Canadian security program is a dual one, providing old-age pensions for persons over 70. It also provides old-age assistance for needy persons between 65 and 70. For persons over 70 the means test is eliminated by providing a universal pension. A flat rate of $40 per month is set for old people over 70.

Naturally, the importance of helping to maintain elderly persons as long as possible cannot be overstressed. The value to the individual and community of continuing work at something socially useful is widely recognized. This is not easy to arrange in an industrial economy. It is one of the greatest challenges in developing social security programs beyond the mere provision of financial assistance.

A report in this line by the British survey committees is in part as follows: Although it is the natural desire of the community to minister generously to the needs of old age, important facts have to be considered. The change taking place in age distribution of the population will eventually result in a great preponderance of elderly people. The older age group will be very burdensome, unless the able-bodied among them continue to work. They should be expected to work after having reached the pensionable age. Otherwise the burden of maintaining the aged may become so great as to result in a lowering of the national standard of living.

If employment and production can be maintained, it seems clear that Canada will be able to overcome such difficulties. It will be possible to finance an adequate program for the aged, in addition to the other health and social services.

Occupational Therapy and Physical Therapy Leading to Rehabilitation.

J. G. Gold.

Am. J. Occup. Therapy **6:** 20–23 and 49–50, 1952.

This is an age of aging, but fortunately homes for the aged have greatly improved. Also occupational therapists take their share of the responsibility for given projects, taking the roles of group workers. They help the old persons to find themselves socially, psychologically and physically. The therapists in rehabilitation must understand the whole problem. The workers in each of the related therapies must acknowledge the status of others. Each one in his own area of interest and expertness should cooperate toward the welfare of the patient.

The therapist as a professional person must be flexible, and guide the patient in the work according to his needs and at his level. It is sufficient if the therapist has the skill to guide the patient. The therapist need not be accomplished in every project which a patient may seek. Conflicts regarding type or extent of work can be minimized by knowledge of when and how to concede.

In rehabilitation, nothing can be accepted as a strict routine. There is no opportunity for regimenting patients. Each individual should be allowed to do as much as he wants. Through guided leadership he will come around to doing things the worker considers necessary.

Working with the patient, the therapist strives to fix a healthy mind within a healthy body. The objective is improvement in the person; excellence in work performance is of minor consequence.

The Danger of Chronic Inactivity in the Aged.

M. Hill.

Lancet, London **2:** 447, 1952.

As much understanding and careful management is required for the aged as is now afforded for infants. Immense strides are possible in the next decades in the reduction of chronic sickness in old age. There are few more miserable sights than a ward of chronic sick elderly invalids. Besides, there is no greater cause of melancholy than idleness. There is also no greater cause of ill health than melancholy. Inactivity in the aged should be overcome, as far as this is possible. Present accommodations and services for this purpose are insufficient. It, therefore, is important for each district to take stock of its resources. They should be used to the best advantage. Many organizations are not fully used from lack of concerted effort. Difficulties also arise in getting the right people into the right places. Elderly patients not in need of hospital treatment help to fill the beds. Other old people die neglected at home because hospitals and homes for the old hold too many people. Those not requiring hospital treatment could live in their own homes if flatlets were available. Many more halfway houses, convalescent homes and permanent voluntary homes are required. Cooperation would be facilitated if several homes were grouped, instead of setting up one large institution. Thus residents of various mental and physical grades could be placed together in congenial surrounds. Shifts without shock can be made if the proper atmosphere is maintained. The residents are accustomed to sharing entertainments and excursions. The trouble is mostly that the aged pay too much attention to their physical ills. Mental deterioration is inevitable with unlimited and unoccupied leisure. Chronic inactivity is even more harmful than ills of the body. If at all possible, at least a short daily walk is recommended, stimulating both to mind and body. Even going up and down stairs in moderation is good exercise. It is also especially beneficial in keeping joints flexible. One of

the skills necessary in nursing old people is knowing when to encourage their getting up. There should be some place for chronic patients where there is every incentive for activities. This would encourage many to be up and about.

FURTHER INVESTIGATIONS INTO CHANGES OF AGING IN THE LEFT ATRIOVENTRICULAR FIBROUS RING.
K. W. Keill and W. Kiaer.
Acta med. Scandinav. suppl. 266, p. 413, 1952.

Senile changes in the left atrioventricular fibrous ring have been thoroughly investigated by the authors. In a number of cases microscopic sections of the atrioventricular ring have been studied. Of 5 females over 80 years of age without grossly visible calcification, 4 showed considerable thickening of the ring. The latter contained few cells and was of dense structure, showing ill-defined demarcation from the myocardium. It was invaded by extensions of the connective tissue. In 5 cases of decidedly visible calcification, certain decalcified sections showed severe degenerative changes in the connective tissue. No accumulation of cholesterol was found, but particles of calcium were seen. In 1 case incipient ossification has been observed. Microscopic sections from younger females were used as controls. The autopsy material, studied especially from this point of view, proved no relation to occurrence of calcification. This was observed neither in the left atrioventricular fibrous ring, nor in the aortic valves of the Mönckeberg type. The foregoing supports the theory that changes in the left atrioventricular fibrous ring constitute a well defined geriatric entity. Such changes may start as degenerative fibrous processes and end in calcification. Changes of this nature are probably the cause of the frequent incidence of cardiac murmurs in old age.

VITAMIN STUDIES IN MIDDLE-AGED AND OLD INDIVIDUALS. VII. ROENTGENOLOGICAL STUDIES OF THE GASTROINTESTINAL TRACT IN PATIENTS WITH HYPOVITAMINEMIA B_1.
R. W. Maxwell, M. Chieffi and J. E. Kirk.
Gastroenterology **20:** 309–314, 1952.

In the small intestine, roentgen manifestations of the deficiency states are as follows:
Hypermotility (early and advanced stage).
Hypertonicity.
Dilatation of jejunum (advanced).
Abnormal segmentation.
Coarsening of mucosal folds in duodenum and jejunum.
Flocculation of the barium shadow (mostly in advanced stage).

Roentgenologic examinations of the gastrointestinal tract were performed in 20 middle-aged and old patients. These patients showed normal thiamine levels. Another group consisted of patients, aged 51 to 90 with blood thiamine concentrations below 2.4 micrograms per cent. This group was re-examined three months later. At that time the blood thiamine level had been returned to normal by oral administration of thiamine hydrochloride. It was found that most of the clinical signs had disappeared. No significant radiologic abnormalities were observed in either group.

However, these findings do not exclude the possibility that more severe grades of thiamine deficiency may show different results. In such cases they may be accompanied by radiologic evidence of gastrointestinal abnormality.

OLD AGE.
George J. Robertson.
J. Maine Med. A. **43:** 31–34 (Feb.) 1952.

The sociologic aspects of aging are twofold—personal and social. Part of the family problems arise from difficulties of financial support for older people through an ever-extend-

ing period of life. The school system must eventually adjust to a gradually decreasing number of young people. Courses for adults should be given a place in any community system of education.

The majority of old people maintain their mental faculties to the full. In 477 individuals Post found 81.8 per cent to be mentally normal; and of the rest 14.4 per cent showed borderline changes in mental functions and habits. Only 3.8 per cent showed evidence of definite psychiatric disability.

Characteristic personality changes in the aged are:

1) Increased conservatism in mental outlook.
2) Exaggeration of life-long character traits, opinions, biases, and prejudices.
3) Progressive loss of interest in new things and situations.
4) Disinclination to form new habits and associations.
5) Impairment of memory for recent events with ease of recall of past memories and indulgences in reminiscence.
6) Decreased span of attention, lessened capacity for mental work, with greater fatigability.
7) Slowing in speed and diminution in accuracy of thought.

The feeling of having outlived one's usefulness and becoming rejected is frequently observed in old people.

The goal of healthy transition from middle age to balanced old age will be attained through better understanding of the normal physiology and psychology of aging; also by greater appreciation of the need for the aged to continue useful interests and activities.

Emotional stress, poor economic situation, unbalanced diet, gastrointestinal disease, poor teeth, ill-fitting dentures, or reduced muscular activities may contribute to discomfort and malnutrition in the aged.

Protein requirements of old people are higher than those of younger adults. A satisfactory allowance for the aged should be one gram of protein per pound of body weight. Provision of a diet high in vitamins and minerals is essential.

Geriatric clinics should be included in the clinic program of all hospitals.

HEMATOLOGIC VALUES IN THE AGED.
J. B. Shapleigh, S. Mayes and C. V. Moore.
J. Gerontol. **7:** 207–219, 1952.

Studies on 50 males and 50 females ranging from 60 to 95 years have been made. The incomplete, inadequate knowledge about the hematologic system in the aged is strongly emphasized. It has been found that peripheral blood and bone marrow do not change strikingly as people grow old. The total volume of red, hematopoietically active marrow probably decreases; however, the remaining amount can maintain erythrocyte values at levels slightly lower than those of young adults. Counts in men remain somewhat higher than in women, but sex difference in the average values becomes less.

No consistent change has been found in the total number of white blood cells. However, the variability of measurements was greater in old subjects than in young. No change of any importance was ascertained in the percentage of the several types of leucocytes or the platelet count.

The results of investigations by other authors are summarized in tables regarding hemoglobin content, number of red cells, white cell differential, reticulocyte and platelet count, volume of red cells, and sedimentation rates of blood.

THE 1953 MEETING OF THE AMERICAN GERIATRICS SOCIETY

The 10th Annual Meeting of the American Geriatrics Society will be held at the Hotel Commodore in New York City, May 28–30, 1953.

All members who plan to attend the meeting should reserve accommodations at the Hotel Commodore at once. The meeting is being held just before that of the American Medical Association and the hotels expect to be filled to capacity. The program is probably the most interesting one that has been arranged for the Society up to the present time.

The Annual Dinner of the Society will be held on Friday evening, May 29, at 7:30 preceded by cocktails at 7:00. Wives and guests of members are welcome.

The Annual Business Meeting will be held Thursday, May 28.

PRELIMINARY PROGRAM

HOTEL COMMODORE

THURSDAY, MAY 28, 1953

8:00 A.M. **Registration** (*South Room*)
9:00 A.M. **Annual Business Meeting** (*South Room*)
2:00 P.M. **General Session** (*West End Ballroom*)

Harold W. Lovell, M.D., *Presiding*

1. Aging Skin
   Eugene F. Traub, M.D., New York, N. Y.
2. Functional Digestive Disease in the Aged
   Sara M. Jordan, M.D., Boston, Mass.
3. Common Blood Problems in Older People
   Paul Reznikoff, M.D., New York, N. Y.
4. Old Age and the Vices
   Russell L. Cecil, M.D., New York, N. Y.

Walter E. Vest, M.D., *Presiding*

5. Bronchial Asthma and Pulmonary Emphysema
   Alvan L. Barach, M.D., New York, N. Y.
6. The Coronary Problem in Relation to Aging
   Robert L. Levy, M.D., New York, N. Y.
7. Clinical Diagnosis of Atherosclerosis of the Coronary Arteries
   Robert E. Mason, M.D., Baltimore, Md.
8. The Heart and Arteries in Mid-Life
   Teofil Kheim, M.D., and William B. Kountz, M.D., St. Louis, Mo.

FRIDAY, MAY 29, 1953

8:00 A.M. **Registration** (*South Room*)
9:00 A.M. **General Session** (*West End Ballroom*)

Cortez F. Enloe, *Presiding*

9. Psycho-Physical Compensatory Adjustments in the Aged
   Edward B. Allen, M.D., and Hollis E. Clow, M.D., White Plains, N. Y.
10. Alcoholism in Geriatric Practice
    Harold W. Lovell, M.D., and John W. Tintera, M.D., New York, N. Y.
11. The Effect of Aging and Arteriosclerotic Cerebral Vascular Disease on the Circulation and Metabolism of the Brain
    Albert Heyman, M.D., and John L. Patterson, Jr., M.D., Atlanta, Ga.
12. Relation of Physiologic Aging to Physical Medicine
    Malford W. Thewlis, M.D., Wakefield, R. I.

Edward Henderson, M.D., *Presiding*

13. A Realistic Approach to Rehabilitation in Geriatrics
    Samuel G. Feuer, M.D., New York, N. Y.
14. Medical Rehabilitation and De-Aging Methods
    C. Ward Crampton, M.D., New York, N. Y.

Panel Discussion

THE INSURANCE COMPANIES AND THE AGING POPULATION
C. L. Reeder, M.D., Moderator

15. Life Insurance
    Howard B. Brown, M.D., Medical Director, Massachusetts Mutual Life Insurance Company, Springfield, Mass.
16. Plan for Retirement
    Paul V. Reinartz, M.D., Associate Medical Director, The Prudential Insurance Company of America, Newark, N. J.
17. Hospitalization Insurance
    C. L. Reeder, M.D., Medical Director, Continental Assurance Company, Chicago, Ill.
18. Disability Insurance
    Harold R. Leffingwell, M.D., Medical Director, Paul Revere Life Insurance Company, Worcester, Mass.

General Discussion

INTERMISSION FOR LUNCH

2:00 P.M. General Session (*West End Ballroom*)

Caesar Portes, M.D., *Presiding*

19. Diabetes in the Elderly
    Alexander Marble, M.D., and Emery C. Miller, M.D., Boston, Mass.
20. Pathology of Myxedema in the Aged
    Prof. Paul Bastenie, Brussels, Belgium
21. Calcium Metabolism in the Aged
    Herta Spencer, M.D., New York, N. Y.
22. The Effects of Androgenic Steroids in Aging Individuals
    Jonas Weissberg, M.D., Sidney Pearson, Ph.D., and T. H. McGavack, M.D., New York, N. Y.

Russell L. Cecil, M.D., *Presiding*

23. Geriatric Gynecology at the New York Hospital
    Ralph W. Gause, M.D., New York. N. Y.
24. Diagnosis and Treatment of Cancer of the Breast in Older Patients
    Louis P. River, M.D., Chicago, Ill.
25. The Management of Prostatism in the Aged
    Norris J. Heckel, M.D., Chicago, Ill.

26. Treatment of Common Anorectal Diseases in the Aged
Caesar Portes, M.D., Chicago, Ill.
27. Indications for Eye Surgery: The Physiological Bases
Arthur Alexander Knapp, M.D., New York, N. Y.

ANNUAL DINNER, Friday, May 29, 1953

West End Ballroom

7:00 P.M. Cocktails

7:30 P.M. Dinner

Geriatrics Comes of Age—Willard O. Thompson, M.D., *Toastmaster*

Magic—Malford W. Thewlis, M.D.

SATURDAY, MAY 30, 1953

8:00 A.M. Registration (*South Room*)

9:00 A.M. General Session (*West End Ballroom*)

Thomas H. McGavack, M.D., *Presiding*

28. The Diagnosis and Management of Acute Pancreatitis in Geriatric Patients
Brock E. Brush, M.D., Ralph Carlson, M.D., and Fred Zeller, M.D., Detroit, Mich.
29. Hiatus Hernia—A Geriatric Problem
Edward Henderson, M.D., Bloomfield, N. J.
30. Abdominal Surgery in the Aged Patient
E. Lee Strohl, M.D., Chicago, Ill.
31. The Surgical Treatment of Non-Malignant Disease of the Biliary Tract in Patients 65 Years of Age and Older
Frank Glenn, M.D., and Daniel M. Hays, M.D., New York, N. Y.
32. Diagnosis and Treatment of Cancer of the Head and Neck
John J. Conley, M.D., New York, N. Y.

Alfred H. Iason, M.D., *Presiding*

33. Postoperative Mortality in the Aged
Max S. Sadove, M.D., and Myron J. Levin, M.D., Chicago, Ill.

Symposium on Fractures of the Hip Joint

34. Management to Improve Longevity in Patients with Fractured Hip
Julian A. Sterling, M.D., and Ralph Goldsmith, M.D., Philadelphia, Pa.
35. Restitutive Surgery of the Hip Joint and its Evolution
Stephen S. Hudack, M.D., Kent L. Brown, M.D., and Robert Cooke, M.D., Cleveland, Ohio
36. Rationale of Immediate Fixation of Fractures about the Hip in Elderly Patients
David M. Bosworth, M.D., New York, N. Y.

INTERMISSION FOR LUNCH

2:00 P.M.–5:00 P.M. Geriatric Day at the William I. Sirovich Day Center, 201 Second Avenue, New York City. Courtesy of Harry Levine, Founder, and Miss Frances King, Director. Physicians, families and guests are welcome to

see the unusual work that is being done at this center. The dramatic group and the orchestra will perform, and visitors may make a tour of the work shop which includes ceramics, sculpture, art and millinery.

TO BE READ BY TITLE

37. Ultrasonic Therapy in Geriatrics
H. J. Behrend, M.D., New York, N. Y.
38. The Essentials for Rehabilitation in the Aged
James L. Blanton, M.D., Clifton Springs, N. Y.
39. Abdomino-Perineal Resection Beyond the Age of Sixty
J. A. Buckwalter, M.D., and S. E. Ziffren, M.D., Iowa City, Iowa
40. Cicero's "De Senectute." An Analysis
Louis Carp, M.D., New York, N. Y.
41. Studies of the Variations in Human Blood Heparin Levels According to Age, Sex and Atherosclerotic Disease
Hyman Engelberg, M.D., Los Angeles, Calif.
42. The Management of Thyroid Disorders in the Elderly
Bernard J. Ficarra, M.D., Brooklyn, N. Y.
43. The Happy Senile
O. L. Friedman, M.D., New York, N. Y.
44. A Test of Vitality
Martin Gumpert, M.D., New York, N. Y.
45. The Significance of Nasal and Respiratory Physiology in the Aging
Emanuel M. Josephson, M.D., New York, N. Y.
46. Diagnosis and Treatment of Gout: Effects of ACTH in the Acute Attack
Fred Kauffman, M.D., Canton, Ohio
47. Psychotherapy of Neurosis and Psychoses in the Elderly
Hans J. Kleinschmidt, M.D., New York, N. Y.
48. Accelerated Aging
C. M. Longstreth, M.D., and George H. Chapman, M.D., New York, N. Y.
49. D.D.T. in Human Fat
William Coda Martin, M.D., New York, N. Y.
50. The Involutional and Senile Psychoses
James L. McCartney, M.D., Garden City, Long Island, N. Y.
51. Proctologic Problems Past Middle Age
J. F. Montague, M.D., New York, N. Y.
52. Hypophysis Cerebri in Psychosis
James W. Papez, M.D., and B. Pearl Papez, M.D., Columbus, Ohio
53. The Treatment of Pulmonary Emphysema in the Aged
William K. Swann and Thomas L. Lomasney, Knoxville, Tenn.
54. Acute Large Bowel Obstruction in the Elderly Patient
Alex W. Ulin, M.D., Paul J. Grotzinger, M.D., and Phyllis Ostrum, M.D., Philadelphia, Pa.
55. Cancer of the Gall Bladder, A Geriatric Problem
Alex W. Ulin, M.D., Seymour Wagner, M.D., and William L. Martin, M.D., Philadelphia, Pa.
56. The Management of Fractures of the Neck of the Femur in the Aged
S. E. Ziffren, M.D., C. L. Beye, M.D., and M. S. Goldstein, M.D., Iowa City, Iowa

SCIENTIFIC SESSIONS ARE OPEN TO THE MEDICAL PROFESSION AND TO THOSE WHO ARE ESPECIALLY INTERESTED IN THE PROBLEMS OF AGING